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THE FOUNDRY TRADE JOURNAL IS THE OFFICIAL ORGAN OF THE INSTITUTE OF BRITISH FOUNDRYMEN; THE WELSH ENGINEERS' AND FOUNDERS' ASSOCIATION, AND THE FOUNDRY TRADES EQUIPMENT AND SUPPLIES ASSOCIATION.

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Forthcoming Events.

Institute of British Foundrymen.

MAY 2.
Lancashire Branch:—Ordinary meeting at Manchester. "The Manufacture of Large Marine Propeller Castings," Paper by Wesley Lambert.

Action and Reaction.

An editorial in the last edition of "The Welder," the house-organ of Murex Welding Processes, Limited, is devoted to a sort of epitaph for cast iron. "Recent journeys which have been made by the Editor in the United States and in Germany show that the substitution of steel [weldings, we presume] for cast iron is proceeding very rapidly. In America it is now the exception to find cast iron being used in the manufacture of electric motors or of electric generators. The yoke piece is almost universally made in mild steel bent up into circular form and welded. The end bearing plates are either formed of mild-steel pressing or are made up in spider form of mild-steel sections welded together. . . .

"The Westinghouse Company of America are pioneers in the use of steel construction for generators. In their case generators up to a 100,000-kilowatts capacity are constructed throughout of steel. For [such a plant] made in cast iron, the cost of patterns alone amounts to a considerable sum, and it is unlikely that such patterns will be used for more than one job.

"At the Leipzig Fair, more than one German machine-tool manufacturer is commencing to use mild-steel construction for the body of machine tools. . . . For grinding machines, not only was the carcass of the machines built up of steel plate welded, but the tables were formed in the same manner, with a resultant saving in weight of more than 50 per cent. The advantages to be gained by substituting steel for cast iron in moving parts are obvious.

"It must not be thought, however, that our home manufacturers are behind in making use of steel in place of cast iron. A lithographic machinery company in Leeds have closed down their foundry and are manufacturing their machines entirely of mild steel. . . ."

To the ill-informed founder, this may read something like the death-knell of grey-iron castings in electrical engineering and machine-tool practice. Fortunately, our latest information is that weldings as motor casings have not been an unqualified success, and in certain cases the manufacturers are returning to their original "love," as they appreciate rigidity and freedom from corrosion. As to such engines as turbo-generators, intelligent patternmaking renders the patterns reasonably utilisable for repeat orders of similar if not quite the identical machine. Time to manufacture strikes us as being of more importance, as such castings occupy valuable floor-space for such a long period.

Finally, as to the question of machine tools, it should be obvious that where moving parts are concerned involving tensile or complicated stresses, then material of high strength should be used, but where rigidity is the main function then unquestionably cast iron is the cheapest and best material to use.

Because the welder handles castings broken in practice, he has acquired some notions of their unsuitability, forgetting that if steel plate had been subjected to parallel conditions it would be bent and probably cause still greater damage.

If an odd foundry or so has shut down on account of the competition from weldings, it should be borne in mind that four firms making castings for the electrical industry have just completed or are envisaging very important extensions to their foundry departments—three in the Midlands and one near Manchester.

International Sand Testing.

In our comment on April 16 on the new edition of the booklet on American sand tests, a misprint was responsible for the phrase "we hope that an effort will be made to make certain of their international acceptance," whereas our original was "to make certain of them internationally accepted," which implies that sand experts might be able to agree on the best American tests for international use, along also with the best British and Continental tests. It was far from our intention to suggest that the American tests as they stand are best for the sands that are used in this country; indeed, it is by no means certain that they represent the very best for any kind of sand. We feel that the research work produced in various parts of the world would be of greater value to all workers in sand if they speak the same language, as far as tests are concerned. The only alternative appears to be the use of what might be called a standard sand, prepared in such a way that it can be tested in all types of apparatus available.

The difficulties in the way will be considerable. Thus, American sands in general are so coarse that sieving is an apparently satisfactory method of separating the various sizes of grain. But sieving is known to be inaccurate, and hence unsatisfactory for fine sands on account of the difficulty of making very fine sieves. In this country, therefore, where the sands are very fine, recourse has to be had to the method of elutriation, or the separation of light and heavy particles by a current of water. No amount of international consideration will alter these two sets of conditions.

Fortunately, the tests required for the daily control of moulding sand are comparatively simple and few in number, and international action is greatly facilitated by the fact that both America and Great Britain have, quite independently, come to the conclusion that for this the most suitable tests are strength and permeability; in the strength test, also, both have independently concluded in favour of the compression test. On the latter test, therefore, only agreement on suitable size and shape is required, and there is enough experience available on the testing of other aggregates like concrete, to make this comparatively easy. Other difficulties will be less easily overcome. Our English method is to hasten slowly, to devise tests that emerge from a fundamental understanding of the nature and properties of the material, and hence which tell most about it in work, rather than to standardise on an empirical basis. The latter method usually has the advantage of convenience, but in the last analysis it may prove to be a less certain guide in practice. The vital question is not what the test figure is, but what it means.

XUM

Correspondence.

[We accept no responsibility for the statements made or the opinions expressed by our correspondents.]

Commercial Tests for Cast Iron.

To the Editor of The Foundry Trade Journal.

Sir,—It is a remarkable fact that Dr. Swift's Paper, reproduced in your issue of April 16, 1931, does not appear to contain any mention of the possible influence of grip length on tensile strength.

Will you permit me to point to a certain fact which strongly suggests that the length of a specimen may have a greater effect in deciding the apparent strength of a tensile-test specimen than the differing tensile properties of specimens cut from near the outside and centre respectively of massive castings?

Is not one of the essential differences between mild steel and cast iron the fact that the former becomes definitely plastic at a certain stress considerably below its ultimate strength, whereas cast iron, although like mild steel it exhibits some plastic yield at low stresses, breaks "short" at a certain stress without first exhibiting considerable plastic extension?

Pursuing this very simple fact and adding to it the fact that no material is perfectly rigid, is it not possible that the skin of a test-piece in tension may be at a higher stress than the centre? If the test-piece is of mild steel and in its outside skin reaches a stress of about 21 tons per sq. in., the outside can stretch about 2 per cent. of its length before the skin stress begins to rise to failure point. It is difficult to controvert the assertion that the centre of a short thick M.S. tensile test-piece can be at a very low stress when the skin is at plastic stress, because the stress at the centre can build up as the test continues, while the skin remains at constant stress.

In the case of cast iron no such evening-up of stress across the section is possible.

Admittedly, metal cut from the centre of a thick casting has less tensile strength than metal cut from near the skin. Nevertheless it is suggested that B.E.S.A. Specification No. 321, to which Dr. Swift refers, would be more consistent if the overall length of the three classes of tensile test-pieces specified were proportional to their respective test diameters instead of being in all three cases about 6 in. long. This would mean making Class L (test diameter 1.785 in.) about 18 in. long, thereby increasing the difficulty and cost of testing. But if the simple proposition stated above is sound it should be possible to correlate diameter and grip length of test specimens cast from the same ladle and make normal commercial tests only on small specimens.

You may care to refer to my letter under the heading of "Mass and Skin Effects in Cast Iron" in your issue of October 30, 1930, in this connection.—Yours, etc.,

A. C. Vivian.

12, Mount Grace Road,
Potters Bar, Middlesex.
April 23, 1931.

Cupola-Melted Malleable Cast Iron.

To the Editor of The Foundry Trade Journal.

Sir,—In Mr. C. Wood's remarks in your issue of April 23 there is certainly a misunderstanding as to the production of black-heart malleable from steel and ferro-alloys in the cupola. The use of steel and ferro-alloys is certainly an aid to obtain a low-carbon content, but this is insufficient. The main characteristics of my patent are high silicon, high manganese and special annealing, factors never before accomplished.

Up to 1927, and long before 1920, I knew quite a number of founders who tried to produce black-heart malleable in the cupola, and, like Mr. Wood, they stopped producing it owing to the impossibility to get constant results either in composition or physical properties.

I tackled the process, and after long researches I made such improvements in respect to composition and annealing that I was able to get results previously unobtainable, such as (1) constant analysis right through the different heats; (2) tensile strength greater than 22 tons per sq. in. on ⅝ in. dia.; and (3) elongation more than 10 per cent. on 2 in.

Its quality is competitive with any black-heart produced from either air or rotary furnace.

The last official tests carried out on April 1 at the Belgium State Railway Laboratory show ten separate tests ranging between 22.5 tons per sq. in. associated with 10 per cent. elongation and 26.5 tons with 13 per cent. elongation.

The similarity of Mr. Wood's process remains to be shown, as mine is working successfully in five different countries. This reply is not for advertising purposes, as my rights in England were assigned nearly four years ago, but only to have credit of a new process which is the result of personal researches.—Yours, etc.,

Christian Kluijtmans.

56, Rue la Commune, Brussels.
April 27, 1931.

Steel Industry and Tariffs.

To the Editor of The Foundry Trade Journal.

Sir,—Mr. Wm. Graham, the President of the Board of Trade, is reported to have said in his speech at Scunthorpe that "the whole object of the tariff is to secure a higher price for British steel." May I point out that this is most emphatically not the case at all. The object of the proposed tariff is to reduce the imports of foreign steel and thus ensure a greater demand for British steel, and consequently for British labour.

If British steelmakers could only sell sufficient of their steel to keep their works and their workmen adequately employed they would have no fault to find with the price. It is possible to go further, and to say that if they could sell their full output they would very soon be able to reduce their prices *without reducing wages*. What the representatives of the British working man do not seem to understand is that when the steel manufacturers ask for protection for their industry, they are mainly asking for full-time employment for their workpeople.

They rightly believe that a substantial tariff would increase the demand for their steel and thus obviously increase their own demand for labour to produce it.

Can it be doubted that "dumping" is actually taking place, and that foreign iron and steel goods are being sold in this country at a price lower than the figure at which they are sold at home? What possible chance have British makers, who are only working one furnace out of every six (as some are), to compete against these prices, no matter how economically they may operate?

I note further in Mr. Graham's speech that apparently their customers are consulted and virtually asked "if they mind the price of steel being increased"! Who could expect them to say anything else but "yes," but if they do, it seems that their answer is to be regarded as an argument against a tariff on steel!

The coal quota scheme is putting coal prices up, but is the voice of the consumer heard in high places? Before a duty was imposed on foreign motor cars and imported tyres, did the Board of Trade leap to the conclusion that "the object of the tariff was to secure a higher price for British cars and tyres"—and were the customers consulted? Has it had this result, or have prices gone steadily down ever since? It seems that what the British steel trade needs is not mercy but justice.

It must be remembered that the foreigner fights from the cover of a tariff wall, whilst our

(*Continued at foot of next column.*)

Random Shots.

To return for a moment to the Ideal Home Exhibition. A correspondent writes that on one stand was displayed a large illustration of the exhibitor's foundry, and, observing it to be technically correct, he congratulated the attendant salesman upon its unusual merit. Whereupon the salesman replied that it was drawn from photographs, and added: "It shows you two melting boilers and the liquid castings coming down the shoots and being emptied into boxes." My correspondent asks whether this qualifies as an example of Mr. Eric Simons's "simple, non-technical language."

* * *

Literary Hint.—Avoid using the *cliché*, and its many variants, "in these days of industrial depression."

* * *

With no little pride, and after much delving into hoary antiquity, "Marksman" is at length able to make known the fruits of his remarkable research into the history of foundrymen's partiality to beer as their favourite beverage. Hidden from sight behind barricades of musty tomes in dim archives, he discovered an anonymous record of a long-forgotten ceremony—the inception of the office of "ale founder." In the year 1511, one Richard Page, founder and ironmonger, was appointed by the lord of the manor of Elsynge to assay the ale and ale measures of the manor for a period of one year, this office to be known henceforth as "ale founder." The ceremony was performed with customary Tudor pomp, after which "in his parlor Master Page and his fellowes did trulie assaye ale into the darknesse of night, and did to bed at dawne 'neath his tour table." A zealous officer, this Richard Page!

* * *

The last day of his auspicious year of office as ale founder Richard made memorable in the chronicles of Elsynge. Noon, and out of his melting house, on to the highway and to Elsynge Monastery he strode: And there the indignant abbot had to submit to his ale and measures being assayed by the ale founder. The Monastery in those days was famous for the high quality and great quantity of its store of ales; and from three in the afternoon to long after vespers Richard was assaying the good monks' ales and declaring them to be monks' good ales. Writes the chronicler: "He did at one drafte drain to the dregs a great [quart] flagon, and so doing arched his back farre over that he fell to the flags." His moulders and carpenters (pattern-makers?) then picked him up and bore him home. Even so, the next morning he appeared to hand the official measures to his successor, a sober cloth merchant. The last reference to him is his death—following a drinking bout—in 1522. Truly a brave end!

Marksman.

(*Continued from previous column.*)

steel trade is not only exposed naked and unprotected to the attacks of the whole world, but prevented by those same tariff walls from doing the export trade that would help to increase its tonnage, and thus reduce its cost per ton. So much talk about the reorganisation of our steel industries is futile until there has been tried the much simpler expedient of giving them a chance to fight their battles behind an armour similar to that of which their enemies abroad enjoy the benefit.—Yours, etc.,

Frank Russell
(Chairman, General Refractories, Limited).

Wicker Arches.
April 20, 1931.

The Surface Treatment of Aluminium and its Alloys.*

The constantly-growing field of technical applications of aluminium and its alloys has made it increasingly necessary to be able to vary the surface, to provide for such requirements as decoration, protection from chemical, physical and mechanical action, electric insulation, the formation of metal connections, and absorption of heat; or combinations of these requirements.

Decorative surface treatment has made great advances. Metal objects generally can receive to-day at the manufacturer's hands, quite apart from the craftsman's or artist's work, as great a range of colour and decorative effects as those in any other media. Aluminium, especially, which has penetrated to so large an extent into the field of small articles where attractive effect is frequently a *sine qua non*, has had a large amount of attention directed towards its more delicate decoration. In the constructional trades, further, a general demand has arisen within the last few years for aluminium parts to be colour-matched to adjacent non-aluminium parts.

Protection offers a much bigger problem to surface treatment of aluminium, the characteristic properties of which are such as to make many of the usual methods either difficult to apply or impossible. With regard to protection from mechanical injury, from the point of view of surface treatment this is largely confined to reduction of frictional wear. In this connection two interesting examples are the use of zinc-plating to prevent aluminium parts from seizing and the recent introduction of a soft rubber surface coating to reduce abrasion. Protection from physical injury is again, from the point of view of surface treatment, limited in practice to providing a surface relatively indifferent to temperature changes. For high temperature resistance the oxidation processes provide a satisfactory solution for aluminium. The question of protection from chemical effect, or corrosion, is by far the greatest problem with which protective surface treatment is called upon to deal.

The Corrosion Problem.

Corrosive agents may be divided into two types: natural corrosive agents, that is, those commonly met with in nature—the atmosphere, moisture, sea water, etc.—and industrial corrosive agents, met with by metals in industrial applications. In the latter case the conditions of corrosion may be said to be stable: in the former case the conditions are by no means constant, and the surface treatment has to be capable of responding to the differing conditions. The first essential of any surface coating from the point of view of chemical protection is that it should be a continuous envelope, sealing completely the metal which it protects: the corrosion attack is then limited to the material of the coating, and can, since the material can be specifically chosen to be inert for the particular conditions, be reduced to a minimum. If the coating is not a completely enveloping surface, that is to say, if it be porous, the corrosive effect will depend on whether the coating is a conductor electrically. If it is not, the rate of corrosion of the basis metal is determined by the rate of access of the corrosive agent: if it be a conductor, electro-chemical action comes into play, and the character and intensity of corrosion effect depend on four factors: (1) the relative solution pressures of the basis and coating metals; (2) the nature of the electrolyte (in "natural" corrosion mixture—atmospheric or NaCl, *i.e.*, sea water); (3) the nature of the anodic and cathodic corrosion products; and (4) the rate of access of oxygen. A porous coating may, instead of reducing corrosion, very greatly increase it. The second necessary factor for a protective coating is that it must have no internal imperfections which might give rise to weakness; for example, it must not contain traces of a bath liquor, nor be internally stressed.

For requirements of electric insulation aluminium oxide stands out among metallic oxides as a good heat-resisting insulating material, and by suitable treatment of aluminium an effective coating of oxide of practically any thickness can be produced. The effective insulation depends on the hardening and thickness of the film; it also depends on the temperature and relative humidity, and for the latter reason an absolutely non-hygroscopic binding agent should be employed where oxidised aluminium wire is used in coils, etc.

For forming metal contacts, aluminium is coated with copper by a special process, and for absorption and radiation of heat various methods of attaining a black plated surface give efficient results, the radiating or absorbing power being increased up to 50 per cent.

Methods Available.

The available methods of surface treatment may be divided broadly into two main categories according as to whether they depend ultimately on chemical or mechanical means. The following classification (Table I) shows the principal applications of the different processes:—

Table I.—*Processes Available for Surface Treatment of Aluminium.*

Type of process.	Nature of process.	Object sought.
Mechanical ..	Pressure plating ..	Protection.
,, ..	Polishing	Decoration.
,, ..	Spray coating ..	,,
,, ..	Painting	Decoration or protection.
,, ..	Ornamental finishing—	
	Scratch brushing ..	Decoration.
	Curling	,,
	Matting or frosting	,,
Chemical—		
(*a*) Pure chemical	Immersion processes:	
	Colouring	,,
	Metal plating ..	Protection.
	Oxidising	,,
	Miscellaneous ..	,,
(*b*) Physico-chemical	Diffusion processes ..	,,
,,	Cementation.. ..	,,
	Oxidation by heating	Protection or insulation.
(*c*) Electro-chemical	Anodic oxidation ..	,, ,,
,,	Electro-deposition:	
	Metal plating ..	,, ,,
	Vulcanising ..	Protection.
	Colouring	Decoration.
	Coppering ..	Forming metal connections.
	Blackening ..	Heat absorption or radiation.
	Miscellaneous ..	—

Certain differences distinguish aluminium from other metals where surface treatment is concerned. Its mechanical qualities, which allow of obtaining a smoother surface than most metals, especially ferrous metals, are advantageous in mechanical surface treatment. Its chemical properties, outstandingly its extreme oxidisability, high position in the electro-motive scale and its high reactivity, on the other hand, place it at a disadvantage for all processes involving chemical reaction: these difficulties have to be overcome by special methods applicable to the class of phenomena entering into the particular process.

Common to all methods of surface treatment is the necessity for a *clean initial metal surface*. In the case of aluminium this is a particularly difficult problem on account of the chemical reactivity referred to, and much research has been carried out on the subject.

The general method of pre-cleaning depends on, first, a de-greasing of the surface with an organic solvent, and, second, an attempt at oxide removal by both alkali and acid pickles, for which a vast number of formulæ exist. For pure aluminium chiefly HCl or HF or mixtures containing the latter or solutions of sodium salts are used: for commercial aluminium and alloys HNO_3 is generally used. In many cases, however, methods special to the post-treatment are prescribed.

Mechanical Methods of Surface Treatment.

Pressure Plating.—A British patent[1] was taken out in 1924 to cover a process for mechanically coating aluminium with a heavy metal such as copper, lead, silver, nickel, etc. The process consisted in heating the aluminium, cleaning the surface with special compounds, continuing the heating to 300-550 deg. C., spreading the layer of a metal such as tin on the face of the aluminium and pressing on a thin cleaned sheet of the heavy metal, using hydraulic pressure, and cooling under pressure.

A mechanical process is also made use of in the German Allautal and Duralplat and the American Alclad alloys, the high tensile strength alloys Lautal and Duralumin being plated by a special pressure process with a considerable plate of pure aluminium which renders the alloys corrosion resistant.

Polishing.

Polishing is rather more difficult in the case of aluminium than in the case of other metals on account principally of its softness: softer polishing wheels are necessary to prevent the metal surface being dragged out and the wheel becoming glazed, and finer abrasives are necessary. The high thermic conductivity and specific heat are also disadvantages, particularly as the coefficient of friction is also high and the heat developed by rubbing is therefore transmitted rapidly through the articles, making handling difficult. There is also the risk of the polishing wheel burning. The one point in favour of aluminium for polishing is its lightness, which facilitates manipulation.

The technique of polishing to give a high mirror-like polish involves three stages after preliminary cleaning—smoothing down the surface (more especially in the case of sand castings), buffing, and rubbing up with a polishing paste. The surface-smoothing is accomplished with coarse-grained files or emery wheels, the surface being kept thoroughly lubricated. Buffing is carried out with soft buffing wheels of chromed leather, felt, rag or calico, using some abrasive powder mixed with a lubricating grease. The final rubbing up is done with a suitable metal-polishing paste such as "Almin."

If a less brilliant surface is considered sufficient, burnishing is substituted for polishing: after pre-cleaning, the articles are placed in a tumbling barrel containing small steel shot in a soap solution and revolved at a high speed, which produces a continuous rolling motion of the shot. On removal from the burnishing barrel the articles are immediately placed in another revolving barrel containing hot sawdust to dry and brighten them.[2] A fair polish can be given to aluminium by simple agitation with a solution of a soap containing sodium silicate.

Spray Coating—Schoop Process.

Spray coating or "metallisation" of aluminium is usually confined to galvanising or coppering, the former either for protective

* Published as an intelligence memorandum by the British Aluminium Company, Limited.

1 A. Passalacqua. E.P. 209,063 (1924).
2 H. Poulain.

reasons or as a preliminary to gilding or plating with other metals, the latter for decorative purposes. The zinc or copper is applied with a Schoop "metal pistol": a wire of the metal is automatically fed through the pistol body into the nozzle where it meets the hot zone of an oxy-blowpipe flame, which is surrounded by a cone of compressed air: the metal, as soon as it becomes molten, is atomised and forced at high velocity against the surface of the aluminium (which is, as usual, pre-cleaned and sand-blasted).

Painting and Enamelling.

The painting of aluminium, contrary to other metals, is probably more important for decoration than for protection, for although much research has been carried out on the subject, no paint medium has been found so far which renders light metals completely resistant to corrosion. Where painting for other metals supplies a primary and sufficient resistance to corrosion (which for most painted metal objects is "natural" corrosion), for light metals it can only be considered satisfactory as a secondary, or at the most complementary, means of protection, its protective powers being confined to preserving some other medium; for example, an oxide film, which is the active protective agent for the metal. Some workers have, however, claimed that certain varnishes and nitro-cellulose paints afford complete ordinary protection, and that bituminous paints afford protection against corrosion by sea-water.

The characteristic mechanical properties of the light metals also contribute to the difficulties encountered in painting, the higher expansion and contraction of these metals making a higher elasticity of the paint coating necessary and rendering the problem of adhesion more difficult. The former property practically limits the choice of paint to the slower-drying oil-paints (although good results have been claimed with cellulose paints and rapid-drying oil-paints by using a smoother). The latter problem devolves into a question of the control of the preparatory surface. For protective painting oxide treatment is usually given preliminarily, and good adhesion of the paint is thereby attainable. For decorative painting the surface must be rendered matt by treating with soda solution and subsequently washing with concentrated acid and hot water. Sandpapering must not be done. For castings, however, the surface should be sand-blasted or smoothed with emery before matting. Many of the special paints on the market for light metals prescribe special cleansing solutions (usually organic) and require that alkaline cleansing liquids shall not be used.

The usual process of enamelling is to employ one coat of primer, one or two coats of coloured enamel and one or two finishing coats, applied either by spraying, brushing or dipping, spraying giving the most durable result. The coats should be applied thinly and given full time to dry; this is important. Typical primers are a 3:1 mixture of turpentine and linseed oil or a 3:1 mixture of raw linseed oil and quick-drying varnish. Ground paints containing zinc salts or red oxide are also used; two such are made up of 300 parts zinc chromate, 225 parts raw linseed oil, 50 parts turpentine, 15 parts cobalt drier; or 40 parts neutral red oxide, 20 parts zinc chromate, 30 parts linseed-oil varnish, 8 parts turpentine and 2 parts japan drier. The enamels most commonly used are cellulose enamels. There are also a large number of proprietary lacquer paints specially produced for light metals—"Glyptal" (phthalic anhydride with glycerine thinned with 50/50 toluol and naphtha), "Inertol," "Tokiol," etc. Two interesting developments in the technique of painting light metals have recently been investigated. Drying has been accelerated by the use of ultra-violet light; and researches have been carried out on combining heat-treatment of light alloys with drying of the paint.

Ornamental Finishing—Scratch Brushing.—A fine satin finish is given to aluminium by a scratch brush running at 1,400 r.p.m., the wheel being run dry and a little lime being used on the wires occasionally to keep them free from oil and grease.

Ornamental Finishing — Curling. — This method, which consists in rubbing the surface over in circles with a cork or tool covered with leather and coated with fine emery, gives a pseudo "engine-turned" surface. The work can be carried out by hand or using a lathe, and different effects can be obtained by making the circles overlap one another in varying designs. The method, however, is tedious and requires careful work, and is therefore expensive.

(To be concluded.)

Nitrogen in Steel.

The Department of Commerce of the U.S. Bureau of Mines has issued Report of Investigations No. 3076 on "The Absorption of Nitrogen by Steel" by Mr. R. S. Dean, who points out that the iron-nitrogen diagram in the solid state, so far as it concerns the nitrogen content of commercial iron and steel, consists simply in a solubility curve increasing with temperature. The important thing about this solubility curve is that, without cold work, the iron nitride when precipitated does not go into solution on heating for long periods below 300 deg. C. This slowness of solution is probably due to the fact that iron nitride when present as a separate phase has, at these temperatures, an equilibrium pressure of several thousand atmospheres and that therefore each particle of iron nitride surrounds itself with a layer of nitrogen. It cannot diffuse then unless this layer is broken through or the temperature and pressure are increased to a point where the nitrogen is absorbed at an appreciable rate in the surrounding iron. This rate will depend on the degree of unsaturation of the iron and the excess pressure of the nitrogen above equilibrium pressure. The degree of unsaturation is determined by the temperature alone, so that the temperature at which the rate of solution of the nitride becomes appreciable will depend on the pressure of nitrogen developed. This, in turn, will depend on the balance between rate of decomposition of the nitride and the rate of flow of the iron. In annealed iron, this temperature of appreciable solution rate is between 300 and 350 deg. C. By cold work, however, the elastic limit of the iron is increased, and conditions for the nitride to go into solution are reached at a much lower temperature, giving rise to the so-called blue brittleness. This brittleness and hardening is due to iron nitride going into solid solution and is not precipitation hardening.

Effect of Nitrogen on the Magnetic Properties.

The effect of nitrogen on the magnetic properties of iron is very startling, and the necessity of controlling the nitrogen content of iron to be used for magnetic purposes is particularly evident. Magnetic measurements on the sample of iron containing 0.07 per cent. nitrogen showed that by quenching from 500 deg. C. the maximum magnetic permeability reached about 4,000 but dropped steadily over a period of several weeks to as low as 150, the coercive force meanwhile increasing. This rather unexpected finding that the coercive force of a heterogeneous mixture is greater than that of a solid solution has been found to be a general phenomenon in magnetic alloys.

Red or white lead can be used for lubricating the centres of grinding machines for heavy work. For lighter work a mixture of graphite and mineral oil can be used.

Institute of British Foundrymen.

LONDON JUNIOR SECTION.

The annual general meeting of the London Junior Section of the Institute of British Foundrymen was held in the offices of The Foundry Trade Journal, 49, Wellington Street, Strand, W.C.2, on April 24, Miss M. D. Pittuck (chairman) presiding. The annual report was submitted by the hon. secretary, Mr. J. P. Ellis, and approved.

Mr. L. H. Howell was unanimously elected chairman for the coming session. On the motion of Mr. L. H. Howell, seconded by Mr. J. Butler, Mr. B. B. Kent was elected vice-chairman, whilst the following were nominated to the council: Messrs. J. Butler, S. Myers and E. Nubley. On the proposition of Miss Pittuck, seconded by Mr. Kent, Mr. J. P. Ellis was unanimously re-elected hon. secretary.

A vote of thanks was passed to the retiring officers for their services during the session, and to Mr. J. P. Ellis for his valuable work as hon. secretary. A vote of thanks was also passed to the proprietors of The Foundry Trade Journal for their continued courtesy in placing their office at the disposal of the Junior Section for its meetings, particular reference being made to the kind assistance of Mr. V. C. Faulkner and Mr. J. Butler.

During the session seven ordinary meetings were held, in addition to which, visits were paid to the works of Messrs. Lister Bros., Woolwich, and Messrs. The Sterling Manufacturing Company, Cubitt Town, London, E.14. On the occasion of each visit the members were kindly entertained to tea by the firm.

The next session will open at the end of September.

Purchasing Conference.

Purchasing agents and buyers of leading industrial firms, spending millions of pounds a year, will hold a conference on works and factory purchasing, in London, on June 5. Lower production costs are vital to Britain's industrial future, and the efficient purchasing of materials and plant can help substantially. The chief speakers at the conference will be Mr. Allan R. Baker (chairman, Baker, Perkins, Limited), Mr. E. J. Fox (managing director, Stanton Ironworks Company, Limited), Mr. J. Gibson Jarvie (chairman, United Dominions' Trust, Limited), Mr. Hugh Quigley (Chief Statistician, Central Electricity Board), Mr. L. H. Swinbank (Controller of Purchases, Imperial Chemical Industries, Limited), and Mr. Reginald Pugh. Full information about the conference may be obtained from Mr. Stanley Townsend, 68, Victoria Street, Westminster, S.W.1.

Notes from I.B.F. Branches.

Lancashire Branch.—Mr. Roy Stubbs, President of the Lancashire Branch of the Institute of British Foundrymen and director of Joseph Stubbs, Limited, ironfounders, Openshaw, was married recently in Manchester to Miss Ethel Seel.

British Insulated Cables, Limited, of Prescot, have received a £100,000 order for overhead transmission lines to link up the new Clarence Dock power scheme at Liverpool, forming part of the North-West England and North Wales grid area.

Institute of British Foundrymen.

ANNUAL GENERAL MEETING OF LONDON BRANCH.

The annual general meeting of the London Branch of the Institute of British Foundrymen was held in the theatre of Edibell Sound Film Apparatus, Limited, 89-91, Wardour Street, W.1, on Thursday, April 16, Mr. A. F. Gibbs (Branch-President) in the chair.

The minutes of the previous annual general meeting were read, confirmed and signed. The Hon. Secretary (Dr. A. B. Everest) reported an apology for absence from Mr. J. W. Gardom.

The Branch-President drew the attention of members to the activities of the London Iron and Steel Exchange, which, he said, is an organisation aiming to bring together the producers and users of foundry materials. The objects of the Exchange were both business and social. Meetings were held on Tuesday in every week, together with special meetings from time to time. Those desiring further information were asked to communicate with Mr. H. W. Lockwood, of Messrs. Stewarts & Lloyds, Limited, of Winchester House, Old Broad Street, London, E.C.2, or the Secretary of the London Iron and Steel Exchange, 28, Essex Street, London, W.C.2.

Secretary's Report.

The Hon. Secretary then presented his Report for the session 1930-31:—

The work of the Branch has been carried on very successfully during the present session in spite of the acute industrial depression through which we have been passing, and in spite also of the difficulties imposed on the Council by the closing of the Engineers' Club, with the consequent necessity of finding fresh accommodation for all functions.

During the year 23 new members and associate members and one subscribing firm have been enrolled in the Institute from the London Branch. The membership list has also been subjected to careful revision and a number of names have been removed of members whose subscriptions are in arrears and with whom the Institute has lost touch. As a result of these deletions and four resignations received during the year, the membership stands to-day at 263 as compared with 265 for the same date last year. Membership is divided as follows, the first figure being that for session 1929-30:—

	1929-30.	1930-31.
Subscribing firms	3	4
Members	156	161
Associate members	92	85
Associates	14	13

The present situation can be regarded as very satisfactory in that the senior grades of membership show a continuous increase, whilst such falling-off as has been met is in the junior grades.

Since the last annual report the death has occurred of Mr. J. Ellis, Past-President of the Institute. The news of his death was received by all members with the deepest regret.

It is with the greatest satisfaction that we have to report the honour done to the London Branch in the election of Mr. W. Lake as the Treasurer of the Institute for the past year. We are also pleased to report the honour done to Mr. V. C. Faulkner in selecting him to present the Exchange Paper on behalf of the Institute at the forthcoming convention of the American Foundrymen's Association. Record must also be made of the honour conferred upon Mr. Wesley Lambert, Past-President of the Institute, and a member of the London Branch, on his being the recipient of the King's honour of C.B.E.

At the monthly meetings during the year the usual wide range of subjects has been presented and discussed. It is gratifying to report an average attendance appreciably in excess of that obtained in previous years. Temporary accommodation has been obtained for the ordinary meetings during the year in the demonstration theatre of Edibell Sound Film Apparatus, Limited. The joint meeting with the London Section of the Institute of Metals, organised this year by our own Branch, was held in the rooms of the Chemical Society and proved the usual popular success.

It has proved very difficult during the year to organise works visits, owing, principally, to the disinclination of works to entertain parties of visitors while, on account of trade depression, a large proportion of their shops have been idle. A notable exception, however, was found in the case of Messrs. Crane-Bennett, Limited, Ipswich, who were kind enough to entertain a party of members of the London Branch, and who show in their shops the signs of great activity and progress. In March a week-end visit was arranged to Messrs. Ford's foundries at Cork, the trip proving most enjoyable to the party of members participating. The best thanks of the Branch are due to Mr. J. W. Gardom for so ably and successfully organising this visit. The annual dinner of the Branch occurred last December and was quite its usual success, nearly 100 members attending, Sir Arnold Wilson being the guest of honour.

The Junior Section associated with the London Branch continues to flourish, and every praise and encouragement is due to those, especially Mr. P. Ellis, who are responsible for its organisation. Finally, the Secretary has to record the generous action of an anonymous member in presenting a lecture lantern, complete with all accessories, to the Branch.

The report was unanimously adopted, and the Branch President referred to the valuable work which Dr. Everest had done during the past year as hon. secretary, and at the same time regretted that Dr. Everest was resigning his position.

Election of Officers.

Mr. H. C. Dews was elected Branch-President for the coming year; Mr. H. G. Sommerfield, Senior Vice-President; Mr. A. W. G. Bagshawe, Junior Vice-President; Mr. S. Evans, hon. secretary; and Mr. A. F. Gibbs, hon. treasurer.

The following three members who retired from the Council, namely, Messrs. Hodgkiss, Delport and Wares, were re-elected, and the vacancy, created by the election of Mr. Bagshawe to the position of Vice-President, was filled by Mr. A. C. Turner.

In connection with the election of representatives to the General Council, it was announced that the retiring members are Messrs. Gardom, Cree and Wares, and they were recommended for re-election. In addition, the Branch being entitled to five members in all, the Council recommended Messrs. Bagshawe and Delport to fill the remaining two vacancies. This was unanimously agreed to.

The Branch-President, in calling upon his successor to take the chair, said that there were two memories which he would take away with him as mementoes of his year of office. The first was the loyal rallying to him of all the members of the Branch and of the Branch Council, without which he would have been an utter failure. The second was the feeling of good fellowship that had spread throughout the Institute and had increased during his year of office. He wished also to refer to the good work done by the General Council and also to the valuable assistance offered by the proprietors of The Foundry Trade Journal, who had opened their columns to members of the Institute who happened to be out of work, and enabled them to seek new posts free of charge. He was pleased to think that the Institute had gone forward during his year of office, and, in closing, he proposed a hearty vote of thanks to the proprietors of The Foundry Trade Journal for what they had done during the past year.

The vote of thanks was carried unanimously.

The new Branch-President (Mr. H. C. Dews) then took the chair, and, after expressing his appreciation of the honour done him by electing him to the position of President of the London Branch, said that during the several years he had been a member of the Branch he had always endeavoured to do his best in the interests of it, and he now looked forward to having an opportunity of doing more in that direction. At the first meeting of the next session he would have an opportunity of expressing some of his views upon directions in which he thought the Institute might usefully advance its work and offering some suggestions towards that end, but for the present he would content himself with assuring the members of the Branch how much he appreciated the trust they had conferred upon him in electing him as President, and how sincere would be his wish that this trust should not be misplaced. He would do his best to further the interests of the Branch, and, at the same time, looked forward to receiving the assistance and loyal support and encouragement of all members of the Branch, without which his own efforts would be very miserable indeed.

Mr. Wesley Lambert proposed a vote of thanks to the retiring President, to Dr. Everest for his services as hon. secretary during the past year and to Mr. Sommerfield the retiring hon. treasurer. Mr. V. C. Faulkner seconded, and the vote of thanks was carried with acclamation.

"Jewels of Industry."

This closed the business of the annual general meeting, after which a film, entitled "The Jewels of Industry," was shown. This dealt with the manufacture and application of carborundum, and depicted the whole process of the experimental work which led to the discovery of the manufacture of carborundum and aloxite, and their application in many forms of industry. The film was shown by courtesy of the Carborundum Company, Limited, who also sent two representatives in Mr. F. G. Harris and Mr. S. H. Harris.

Mr. F. G. Harris said it had given the Carborundum Company the greatest possible pleasure to show this film, and commented upon the fact that the film was not a studio film, but one taken under actual workshop conditions, which necessarily introduced many difficulties.

Mr. S. H. Harris subsequently invited questions, and an informal discussion took place between him and several members who were anxious to obtain information on certain points.

On the motion of the President, a cordial vote of thanks was passed to the Carborundum Company for the trouble they had taken in showing the film and also in sending representatives to the meeting.

When sawing steel use a speed of from 50 to 60 strokes per minute; this can be increased to 130 strokes per minute when sawing steel tubing.

Beryllium and Steel.—According to a communication in "The Chemical Age," in the search for a form of heat-treatment for steel that would protect it against the streams of hot hydrogen used in the Berginisation process, it was found that by spraying the steel with metallic beryllium and allowing it to remain heated at 900 to 1,150 deg. C. the beryllium diffused into the steel giving a case that would withstand the action of the hot hydrogen. The alloy containing 20 of chromium, 7 of nickel, 1 of beryllium and 72 of iron has a Brinell hardness of 480, and has been used as a high-speed tool steel. Siemens-Halske, in Germany, have a similar alloy containing up to 25 per cent. of chromium, tungsten, molybdenum or vanadium; 0.1 to 2 per cent. of nickel; 1 to 12 per cent. of beryllium and the remainder of iron. Such an alloy is quenched for use from 800 to 1,200 deg. C. and can be age-hardened from 300 to 700 deg. C.

XUM

Jubilee Celebrations of the Society of Chemical Industry.

Jubilee celebrations of the Society of Chemical Industry will take place in London during the week commencing July 13, under the patronage of His Majesty the King. The proceedings will be under the presidency of Sir Harry McGowan, President of the Society, and will comprise a wide programme of scientific discussions, social functions and visits to industrial centres. Several hundreds of the Society of Chemical Industry's 7,000 members are to attend from overseas, and the celebrations will open with a reception by the Lord Mayor of London at the Guildhall.

The annual general meeting of the Society will be held in the Duke's Hall, Marylebone, on Tuesday, July 14, when Sir Harry McGowan will deliver his Presidential Address. In the afternoon a garden party arranged by the Shell Royal Dutch Oil Group will take place at Teddington. Wednesday will feature the presentation of the Society's medal to Dr. Herbert Levinstein, and the annual dinner at the Great Central Hotel. On Thursday evening a reception is to be given by the President at the Savoy Hotel.

During the celebrations, honorary membership of the Society—a very rare distinction, only previously awarded on six occasions during the 50 years of the Society's existence—is to be conferred on representative leading members of the chemical industry in each of the world's principal industrial countries, and a feature of the proceedings will be the delivery of addresses by these distinguished scientists on various days during the celebration week. In addition there will be meetings for the reading and discussion of Papers, lectures and addresses, and an interesting meeting at the Great Central Hotel, when Papers presented by the Canadian sections of the Society will be read.

A very wide selection of works and factory visits have been arranged. Amongst the well-known firms whose works will be visited may be mentioned Achille Serre, Limited, British Drug Houses, the General Electric Company, South Metropolitan Gas Company, Burroughs, Wellcome & Company, Huntley & Palmer, Limited, and J. Lyons & Company, Limited. The Anglo-Persian Oil Company's research station at Sunbury, and the National Physical Laboratory and Chemical Research Laboratory at Teddington will also be inspected by large parties.

Throughout the week of the celebrations a comprehensive exhibition of British chemical plant and research and recording instruments, arranged by the British Chemical Plant Manufacturers' Association in co-operation with the Chemical Engineering Group of the Society of Chemical Industry, will be held at the Central Hall, Westminster. The exhibition, which will be opened by Sir Harry McGowan on Monday morning, will cover the whole range of the industry, and practically every important firm of British chemical-plant manufacturers will be exhibiting. A section will be devoted to the work of the Department of Scientific and Industrial Research, and of the various research associations dealing with the following industries: Cast iron; non-ferrous metals; boots, shoes and allied trades; leather; linen; paint, colour and varnish; rubber; and wool.

The social side of the occasion has not been neglected, and there will be motor drives, river trips, visits to Oxford, Windsor, Eton and Hampton Court, and conducted tours through London.

In order to accommodate their many overseas visitors to Dursley, Messrs. R. A. Lister & Company, Limited, have converted "The Towers," the home of the late Sir Ashton Lister, the founder of the firm, into a private hotel.

I.B.F. Elects New Members.

At a meeting of the General Council of the Institute of British Foundrymen, held at the Central Station Hotel, Glasgow, on April 18, the following gentlemen were elected to the Institute's various grades of membership:—

As Subscribing Firm.

Messrs. Shaw & McInnes, Limited, ironfounders, Firhill Ironworks, Glasgow, N.W.

As Members.

J. Blackett, director, Blackett, Hutton & Company, Guisbrough; J. Blackett, steel founder, Blackett, Hutton & Company; W. Blackett, steel founder, Blackett, Hutton & Company; S. Brooks, representative, General Refractories, Limited, Sheffield; H. Brown, engineer, Hadfields, Limited, Sheffield; J. L. Crawford, iron manufacturer, Glencairn Iron Works, Coatbridge; E. C. Dickinson, M.Met., chief chemist and metallurgist, Morris Motors, Limited, Coventry; E. H. Doyle, founder, W. Murrell & Company, London, S.E.; J. Dunn, works manager, G. & L. Hill, Willenhall; J. M. Ferguson, departmental manager, D. Colville, Limited, Motherwell; W. A. James, foundry foreman, Boulton & Paul, Limited, Norwich; B. N. Jolly, foundry engineer, Muir Hill, Old Trafford; R. Laing, superintendent engineer, Sheffield Steel Products; J. McIntyre, foundry manager, Mirrlees Watson & Company, Limited, Glasgow; F. H. C. Oram, foundry foreman, Natal Estates, Limited; H. S. Rooke, pig-iron salesman, Staveley Coal & Iron Company, Limited; C. H. Sanders, works manager, Newton, Chambers & Company, Sheffield; D. McH. Semple, engineer, Mirrlees Watson & Company; J. G. A. Skerl, D.Sc., Department of Applied Science, Sheffield University; W. Steel, foundry foreman, South India Railway, Golden Rock, S.I.; G. M. Ure, ironfounder, Smith & Wellstood, Bonnybridge; J. D. Wilson, steelfounder, Carntyne Steel Castings Company, Renfrew; A. Wynn, works superintendent, Midland Electric Manufacturing Company, Birmingham.

As Associate Members.

H. Armitage, foreman moulder, J. Grundy, Limited, Tyldesley; D. A. Baird, ironfounders' clerk, Smith & Wellstood, Bonnybridge; T. C. Baird, foreman moulder, J. Howden & Company, Glasgow; W. P. Blumfield, foundry foreman, Ransomes, Sims & Jefferies; J. W. Bruce, foreman moulder, Brown Bros. & Company, Edinburgh; J. Cameron, junr., ironfounder, Cameron & Roberton, Limited, Kirkintilloch; K. P. Chaudhury, mechanical-engineering improver, Worthington-Simpson, Newcastle-upon-Tyne; C. D. Davy, draughtsman, J. Davy & Company, Elsecar; J. Dearden, ironfoundry foreman, Hargreaves & Jennings, Tottington; G. Elston, analytical chemist, R. & W. Hawthorn, Leslie & Company; J. Govan, foundry engineer, Singer Manufacturing Company; H. S. Halsall, foundry draughtsman, Sheepbridge Coal & Iron Company; A. N. Harley, apprentice, Daimler Company, Limited, Coventry; J. A. Harrison, metallurgist, Daimler Company, Limited; W. Haworth, moulder, Harling & Todds, Burnley; A. Hay, foreman moulder, Cruikshank & Company, Denny; J. Hird, assistant foundry manager, R. A. Lister & Company, Dursley, Glos; W. Howard, foreman patternmaker, Qualcast, Limited, Derby; W. Jacques, foundry foreman, Daimler Company, Limited; A. Low, patternmaker, A. Low & Sons, Motherwell; A. Miller, foreman moulder, Mitchell, Russell & Company, Limited, Bonnybridge; W. Moncrieff, engineer, R. & A. Main, Limited, Falkirk; B. Owston, chemist, Blackett, Hutton & Company, Guisbrough; J. C. Palmer, assistant works manager, Southern Railway, Eastleigh; F. Peirson, foreman patternmaker, Blackett, Hutton & Company, Guisbrough; W. Postgate, secretary, Blackett, Hutton & Company, Guisbrough; F. Price, foreman moulder, R. & A. Main, Limited, Falkirk; J. Richardson, assistant to foundry manager, Brightside Foundry & Engineering Company; T. E. Thompson, engineer, T. Robinson & Sons, Rochdale; A. Walker, clerk, Shotts Iron Company; W. H. Williamson, foreman moulder, T. Robinson & Sons, Rochdale.

As Associates.

W. A. Beresford, chemist, W. Shaw & Company, Middlesbrough; T. Cowgill, assistant foundry clerk, J. Stubbs, Limited, Openshaw; E. V. O'Reilly, moulder, Metropolitan-Vickers Company, Limited; G. Walker, foundry apprentice, Coalbrookdale Iron Works; J. Watson, moulder, Lennox Foundry, Alexandria.

General Meeting of the German Foundry Technical Association.

On Saturday, May 16, at 3.30 p.m., the German Foundry Technical Association will hold its 21st annual general meeting in Berlin. The educational exhibition "Modellbau" (pattern-making) will be opened in the morning of the same day. The agenda of the general meeting will include the following lectures:—(1) "Slag Formation in the Cupola, with special reference to the use of Fluorspar," by Prof. Dr.-Ing. Uhlitzsch, Freiberg/Sa.; (2) "Basic Principles of Alloying of Cast Iron with Various Metals," by Dr. F. Roll, Leipzig; (3) "Tensile Strength, Transverse Strength and Graphite Structure," by Dr.-Ing. F. Brinckmann, Sprottau; (4) "Work and Economy," by Prof. D. Karl Dunkmann, Berlin.

At the conclusion of the official part of the programme there will be a "beer evening," held in the Römersaal, Kroll Café, Platz der Republik.

In connection with the general meeting the Institute of the Technical High School of Berlin is arranging in conjunction with the German Foundrymen's Technical Association, with the German Association of Metallurgy and the Association of German Non-Ferrous Foundries, the following Non-ferrous Foundry Technical High School lectures, to be given on May 18-19, in the Technical High School of Charlottenburg:—

(1) "'Tombasil,' a new Silicon-Zinc-Copper Alloy," by Dr. E. Vaders, Finow (Mark).

(2) "Tin Bronzes, other Bronzes and Red Brasses as Chemical Resisting Alloys in Engineering Practice," by Dr. W. Claus, Berlin.

(3) "The Foundry of Ferdinand von Miller at Munich—a German Development in Art Metal Castings," by Dr.-Ing. Fr. Goederitz, Berlin.

(4) "Water-cooled Chill Moulds for Rolls and Press Blocks," by Dr.-Ing. K. Scherzer, Lammersdorf.

(5) "Binary Lead Bronzes and Ternary Lead-Tin-Bronzes," by Dr. W. Claus, Berlin.

(6) "Sand-blasting," by Prof. U. Lohse, Hamburg.

(7) "The Influence of Steel Shot in Sand-blasting," by Dr.-Ing. G. H. Zirker, Berlin.

(8) "Cleaning Castings with High-pressure Water," by Dr.-Ing. A. Rodehüser, Durlach.

(9) "Quartz-sand Cores (Oil-sand Cores), with special reference to Non-ferrous Foundry Practice," by Obering. H. Kupper, Hanover.

(10) "Snap-flask Moulding," by Obering. H. Hartmann, Hanover.

Furthermore, a visit has been arranged to the non-ferrous foundries of the Siemens-Konzerns, Berlin-Siemenstadt. Tickets for members, 10 marks, can be obtained from the management of the Vereins Deutscher Giessereifachleute, at 100 Friedrichstrasse, Berlin, N.W.7.

Also there has been arranged a 2-day course of lectures and demonstrations on X-ray practice. Altogether a matter of seven lectures will be given, together with a limited amount of practical handling of the apparatus. A charge of 7.50 marks is being made for the complete course.

The Desulphurising and Refining of Grey Cast Iron with Soda Ash.

By E. W. Colbeck and N. L. Evans.

It has been known since the middle of the last century that soda ash added to molten cast iron exerts a desulphurising influence. The use of the process in this country has been confined to a few foundries making iron to low-sulphur specifications. A large number of patents covering mixtures of soda ash with caustic soda, potassium salts, fluorspar, etc., have been taken out; these patents emanate chiefly from America and Germany. In many cases they specify the fusing of the salts and casting into blocks, or briquetting. The authors have, however, not been able to trace any published systematic investigation of the subject. There have been a number of brief references in the technical Press, mainly to work carried out in Germany and America. Recently, greater interest has been displayed in the possible application of the process in this country.

The present article is based on research work carried out in the last few months by the authors; this work was undertaken with the object of making a more systematic survey of the process. The results obtained during the work on grey iron are thought to be of sufficient interest to warrant their publication. Experiments have been carried out on a laboratory scale and have been fully confirmed by large-scale tests in the foundry.

Reference to the pig-iron statistics recently published in this Journal shows that pig-irons used in this country are not abnormally high in sulphur; in the main, sulphur contents of irons other than mottled or white range between 0.05 and 0.10 per cent. The sulphur content of the finished casting is frequently very considerably higher due to the remelting of scrap and to pick-up from the coke in the cupola; sulphur contents of 0.13 per cent. and upwards are often found. There are a number of specifications, such as B.E.S.A. 5024 (Iron castings for air-cooled jacketed cylinders for automobiles) and B.E.S.A. 5025 (Iron castings for sand-cast pistons and valve guides for automobiles), also various unofficial specifications which call for sulphur contents not exceeding a definite figure. Further, if the metal is required for blowing into steel by the Tropenas converter, concentration to the extent of 20 per cent. will occur, increasing the sulphur content in proportion; for steel castings it is desirable to keep the sulphur below 0.06 per cent.; to obtain this figure in the ordinary way it is necessary to use very low-sulphur pig-iron, small percentages of scrap and high-grade metallurgical coke.

The present work shows that reductions of 50 per cent. in the sulphur content of ordinary foundry metal containing 0.10 to 0.15 per cent. sulphur can easily be obtained by the use of up to 1 per cent. soda ash in the ladle. In addition, improved physical properties are imparted to the iron, the iron is cleaner and contains fewer non-metallic inclusions; also there is evidence that a degasifying action takes place. It has been found that the ordinary standard commercial grades of soda ash give the best results; no additional advantages are obtained by fusing the ash and casting it into blocks.

How Soda Ash is Used.

A short description of how the soda ash is used in ordinary foundry practice is given below, and it will be seen that very little disturbance of ordinary foundry routine is involved. It is desirable that good separation of slag and metal should be effected in the cupola; the metal should be tapped out as hot as possible, and should preferably be between 1,400 and 1,450 deg. C. Prior to tapping, the necessary amount of soda ash is placed on the bottom of the ladle; the ash should be dry, as any moisture present tends to make the reaction rather violent. The best results have been obtained when a ladle of fairly large capacity is used, say over 1 ton; and if it is desired to run small castings the metal in the main receiving ladle can be tapped off into hand shanks.

The metal from the cupola is run on to the ash and a considerable but by no means dangerous reaction takes place; as soon as this commences to die down a thin soda slag can be seen on the surface of the iron; this slag appears to be boiling due to the evolution of CO_2. The main chemical action involved is

$$Na_2CO_3 + \frac{MnS}{FeS} = Na_2S + CO_2 + \frac{Mn}{Fe}$$

Fig. 1.—Untreated Metal, showing Sulphide Inclusions. × 190.

Fig. 2.—Metal treated with Soda Ash. × 190.

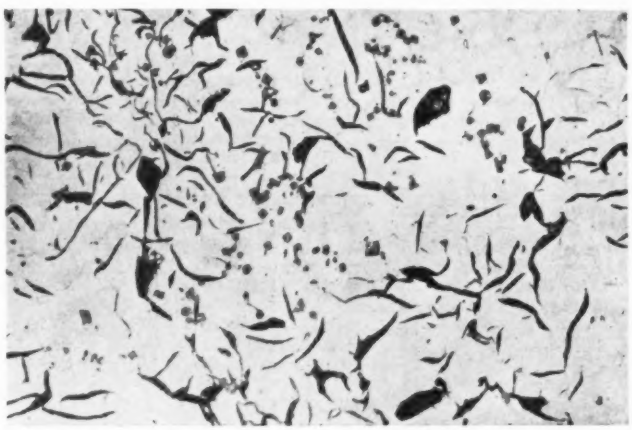

Fig. 3.—Untreated Metal, showing Segregated Patch of Sulphide Inclusions. × 130.

Fig. 4.—The Metal shown in Fig. 3 remelted and treated with Soda Ash. × 130.

There are other subsidiary reactions, and there is a tendency in the presence of a silicate slag for the sodium to form $Na_2O.SiO_2$ and for the sulphur to pass back into the melt. The evolution of CO_2 due to its stirring action continually brings fresh metal into contact with the slag, ensuring that the reaction takes place throughout the molten iron.

Normally a satisfactory reduction of the sulphur content is obtained in as short a period of time as five minutes; where the cupola is being tapped intermittently, the second and subsequent batches of metal are run through the refining slag, giving it an additional stirring action which assists the efficiency of the removal of sulphur. When the ladle is full, a quantity of ground limestone, about half the weight of the soda ash used, is thrown on to the soda slag and rabbled into it. The slag thickens up, the limestone acting as an absorbent for the thin soda slag, which can then be raked off. It is desirable that this slag should be removed as completely as possible and as soon as it commences to thicken. The practice of using sand as a thickening agent should be avoided, as the silica tends to combine with the soda and reverse the reaction, as mentioned above.

Table II.—*Cupola Experiments making Iron for Tropenas Converter.*

Sample No.	Description.	S content. Per cent.	Reduction in S. Per cent.
1	Cast iron. 1st heat, before desulphurising	0.079	
2	Cast iron. 1st heat, after desulphurising	0.033	57
3	Finished steel, 1st heat ..	0.036	
4	Cast iron. 2nd heat, before desulphurising	0.087	
5	Cast iron. 2nd heat, after desulphurising	0.035	60
6	Finished steel, 2nd heat ..	0.039	

The iron is then cast in the normal way, or if it is required for steel making, run into the converter. Attempts to desulphurise steel in the ladle in a similar manner have not so far led to successful results.

Cupola Experiments.

The results of experiments carried out at a foundry using a 36-in. dia. cupola are given in Table I. The charge to the cupola was made up of one part No. 3 Holwell pig-iron and two parts best machinery scrap. The experiments were carried out as described above; the iron was tapped into a 30-cwt. capacity ladle at about 10 cwts. at a time. A number of ordinary castings were run at the same time as the special test-bars and these were quite satisfactory. The results show a reduction of over 50 per cent. of the sulphur content of the iron; a slight reduction has taken place in the silicon content; the manganese content remains constant. The physical properties of the iron are improved. The desulphurised iron is cleaner and contains fewer non-metallic inclusions. Fig. 1 shows a typical cluster of manganese-sulphide particles in the untreated metal, and Fig. 2 shows desulphurised metal practically free from such inclusions.

Steel Castings.

Table II gives the results of experiments at a foundry making steel castings by the Tropenas process. The steel scrap and high-silicon pig-iron were melted in a cupola, the molten iron was desulphurised in a 30-cwt. receiving ladle, and the desulphurised metal transferred after deslagging to the converter and blown to steel in the usual manner. Spoon samples were taken of metal leaving the cupola, and from the analyses of these and the desulphurised iron, it will be seen that the sulphur has been reduced by 57 and 60 per cent. The slight increase in the finished steel, as compared with desulphurised iron, is accounted for by concentration in the converter.

Crucible Experiments.

Several experiments have been carried out by melting 80-lb. charges of metal in a crucible in a natural-draft pit furnace. Reductions in sulphur of the order of 40 per cent. were obtained by pouring the molten metal on to the required amount of ash in a second heated crucible. The physical properties of the iron were improved, and it had a cleaner and more refined structure.

Laboratory Experiments.

A number of 14-lb. melts were made in a high-frequency induction furnace and test-bars cast from the metal. The melting procedure was as follows: Several different high-sulphur irons were made up by melting scrap of known analysis, and adding to it suitable quantities of ferrous sulphide. This material was broken up and remelted. When the desired temperature was reached the bath was deslagged, the current switched off, and soda ash thrown on the surface of the melt. When this was done a strong smell of SO_2 was invariably noticed. After the required time, the soda slag was thickened up with limestone or slaked lime, and removed. The current was then switched on and the bath raised to pouring temperature. The variables were examined systematically, with the following results:—

(1) *Variations in Original Sulphur Content of Iron.*—(See Table III.) The results showed that (*a*) between the limits of 0.13 and 0.60 per cent. sulphur in the original charge, and using a constant amount of ash, the reduction of sulphur is greater, the higher the sulphur content of the original metal; (*b*) the blank charge showed an increase in sulphur content. This is due to concentration, and in order to determine the full effect of ash treatment this amount (0.015 per cent.) should be added to the sulphur reductions calculated from analyses; (*c*) soda-ash treatment

Table I.—*Cupola Experiments.*

Cast No.	Analysis. S. Per cent.	Si. Per cent.	Mn. Per cent.	Ash added. Per cent.	Details of desulphurisation. Temp. when ash added in deg. C.	Time soda slag on in min.	Pouring temp. in deg. C.	Physical tests. Transverse.* Tons.	Tensile. Tons per sq. in.	Compression. Tons per sq. in.	Microstructure. Unetched.	Etched.
1	0.14	2.35	0.54	None	—	—	1,290	1.451	10.60	43.20	Graphite of normal size. Fine particles of MnS and other non-metallic inclusions. Rather dirty	Fine pearlite, phosphide eutectic and some ferrite.
2	0.13	2.18	0.54	None	—	—	1,290	1.296	10.60	43.64	Ditto, and a little unsound	Ditto, but more ferrite and coarser pearlite.
3	0.12	2.13	0.49	None	—	—	1,160	1.243	11.39	42.56	(Same as 1)	Ferrite and pearlite in almost equal quantities. Pearlite coarse.
4	0.062	1.93	0.53	1 approx.	1,360	13	1,160	1.396	12.20	44.32	Cleaner than 1, 2 and 3. MnS almost absent. Rather coarse graphite	Fine pearlite. Less ferrite than in 1. Phosphide eutectic.
5	0.054	2.00	0.54	Do.	1,310	9	1,170	1.312	11.08	44.12	Ditto	Ditto.
6	0.058	1.98	0.52	Do.	1,300	8	1,210	1.345	11.44	45.28	Not quite so clean as 5. A few very small MnS inclusions	Ditto.

* Test bars 2 in. × 1 in. × 42 in. Broken on 36-in. span.

Table III.—*Variations in Sulphur Content of Metal Treated.*

Cast No.	—	Analysis. S. Per cent.	Si. Per cent.	Mn. Per cent.	Ash added. Per cent.	Details of desulphurisation. Temperature when ash added in deg. C.	Time soda slag on in min.	Pouring temperature in deg. C.
X.24	Charge ..	0.13	2.01	0.65	0.5	1,430	10	1,300
	Cast ..	0.054	1.59	0.48				
	Reduction	0.076	0.42	0.17				
X.25	Charge ..	0.19	1.96	0.45	0.5	1,385	10	—
	Cast ..	0.10	1.58	0.32				
	Reduction	0.09	0.38	0.13				
X.26	Charge ..	0.24	1.90	0.36	0.5	1,370	8	—
	Cast ..	0.14	1.59	0.19				
	Reduction	0.10	0.31	0.17				
X.27	Charge ..	0.60	2.13	0.07	0.58	1,400	9	1,270
	Cast ..	0.48	1.55	Not detected				
	Reduction	0.12	0.58	0.07				
X.28*	Charge ..	0.047	2.10	0.90	None	—	—	1,270
	Cast ..	0.062	1.95	0.71				
	Reduction	0.015 Gain	0.15	0.19				

* Blank charge.

causes a reduction in silicon content. It will be observed from the results in Table I that this loss is not so great on a practical scale; and (*d*) manganese is not appreciably affected by ash treatment.

(2) *Variations in Quantity of Ash Used.*—(See Table IV.) The results indicated that (*a*) between the limits of 0.225 and 1.5 per cent. of ash, the reduction in sulphur content is roughly proportional to the amount of ash added; and (*b*) the greater the amount of ash, between the above limits, the fewer are the non-metallic inclusions remaining in the metal.

(3) *Variations in Reaction Time.*—Between the limits of 5 and 14 minutes, during which the soda slag remains on the metal, its efficiency is almost the same—*i.e.*, practically the same amount of sulphur is removed in the short as in the long period.

(4) *Use of Two Soda Slags.*—An iron containing 0.22 per cent. sulphur was treated with two slags, the first being removed with limestone in the usual manner before the second lot of ash was thrown on the melt. The iron as cast contained 0.05 per cent. sulphur, the reduction being 77 per cent. Where a very rigid specification has to be complied with, this method may prove useful.

(5) *Treatment of Low-Sulphur Irons.*—(See Table V.) A very considerable sulphur reduction is obtained, even on iron originally low in sulphur. A comparison of melts Y.27 and Y.28 is interesting, as it shows the results of treating a comparatively high-silicon iron, and the very marked improvement in physical properties of the desulphurised iron is evidently due to the clean degasified metal, as the silicon content remains the same in both casts.

Applications of the Process.

Reference has already been made to the advisability of desulphurising iron which is to be blown to steel in the Tropenas converter. It is known that serious cracking of castings is liable to occur if the sulphur content is 0.09 per cent., yet this is a figure which may easily be reached in view of the frequent remelting of scrap which occurs. By the use of soda ash at the rate of about 20 lbs. per ton of metal, it is possible to reduce a sulphur content of 0.10 per cent. in the metal to something below 0.04 per cent. This enables a foundry to use up to 70 per cent. of scrap in the cupola charge.

The very considerable scouring action of the soda slag, which removes a large proportion of the non-metallic inclusions from the metal, is likely to be of considerable interest to foundries producing castings which are to be submitted to hydraulic test. There is always a possibility of such inclusions occurring in segregated patches, such as that shown in Fig. 3. Fig. 4 shows the same iron after remelting and desulphurising. Freedom from non-metallic inclusions is also an important factor in irons exposed to any sort of corrosive action. It has been the authors' experience that premature failure frequently occurs locally in castings used for chemical plant, where segregations of non-metallic inclusions exist.

According to recent published information, most of the cokes available for metallurgical purposes have sulphur contents of about 1.5 per cent. Cokes with specially low sulphur contents are chiefly obtainable from Durham and certain Lancashire coals, and these have sulphur contents of about 0.8 per cent. Foundries unfavourably situated as regards supply of low-sulphur cokes naturally have to pay more for them on account of transport charges, if they have to produce castings of low sulphur content. The employment of soda ash may easily permit the use of local cokes, where, apart from sulphur content, the properties are satisfactory.

Action on Refractories.

There is no doubt that prolonged exposure of siliceous refractories to slags containing sodium compounds results in serious attack. In foundries, when ladles up to 2 tons are used, it is usual to line the ladle with a ganister daub, which is knocked out at the end of the day's run. Under these circumstances the question of lining attack does not arise. However, where large brick-lined ladles are employed, the best results are to be obtained by using Scotch fireclay bricks having a close even texture and good resistance to spalling. Joints should be kept as thin as possible, and a graphite wash is of considerable assistance in retarding attack.

Table IV.—*Variation in Quantity of Ash Used.*

Cast No.		Analysis. S. Per cent.	Si. Per cent.	Mn. Per cent.	Ash added. Per cent.	Details of desulphurisation. Temp. when ash added in deg. C.	Time soda slag on in min.	Pouring temp. in deg. C.	Microstructure. Unetched.	Etched.
Y.26	Charge	0.25	1.60	0.43	1.5	1,400	9	1,350	Fairly fine graphite. Very few MnS inclusions, but rather more than in Y.12	—
	Cast	0.073	1.17	0.15						
	Reduction	0.177	0.43	0.28						
Y.12	Charge	0.205	2.00	0.30	0.9	1,400	9½	1,280	Fine graphite. Very few MnS inclusions.	Pearlite, cementite and phosphide lakes.
	Cast	0.080	1.65	0.16						
	Reduction	0.125	0.35	0.14						
Y.7	Charge	0.25	2.07	0.44	0.45	1,400	10	1,270	Fine graphite. Some MnS and a few oxide specks	Pearlite, cementite and phosphide lakes.
	Cast	0.14	1.70	0.22						
	Reduction	0.11	0.37	0.22						
Y.13	Charge	0.23	2.00	0.33	0.225	1,400	9½	1,280	Fine graphite. More MnS than Y.12	Pearlite, cementite and phosphide lakes.
	Cast	0.19	1.70	0.19						
	Reduction	0.04	0.30	0.14						

The authors wish to express their thanks to the directors of Imperial Chemical Industries, Limited, for permission to publish this work, which was carried out in the Research Department of their subsidiary company, Brunner, Mond & Company, Limited, Northwich.

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Mott and Wheeler. "First Report of the Midland Coke Research Committee."

C. H. and N.D. Ridsdale. "Economic Utilisation of British Pig-Iron Resources." Foundry Trade Journal. Vol. XLIII. 1930.

Trade with the Soviet Union.—The subjoined figures show the percentages of the Soviet Union's total exports to (and imports from) the undermentioned three countries in the fiscal year 1929-30:—United Kingdom, 27 (9.4); United States, 5 (33.5); Germany, 24 (28) per cent.

Table V.—*Desulphurisation of Irons of Different Analysis.*

Cast No.	—	Analysis. S. Per cent.	Si. Per cent.	Mn. Per cent.	Ash added. Per cent.	Details of desulphurisation. Temp. when ash added in deg. C.	Time soda slag on in min.	Pouring temp. in deg. C.	Physical tests. Transverse.* Tons.	Tensile. Tons per sq. in.	Compression. Tons per sq. in.	Microstructure. Unetched.	Etched.
Y.17†	Charge ..	0.09	1.50	0.76	None	—	—	1,280	4.52	13.54	54.48	Fine graphite. A moderate number of MnS inclusions and oxide specks	Lamellar pearlite, phosphide lakes and some ferrite.
	Cast ..	0.10	1.24	0.51									
	Reduction ..	0.01 (gain)	0.26	0.25									
Y.18	Charge ..	0.09	1.50	0.76	1.35	1,340	8	1,210	5.71	16.08	61.08	Fine graphite. Very few MnS inclusions, a few oxide specks	Pearlite cementite and phosphide lakes.
	Cast ..	0.046	1.03	0.47									
	Reduction ..	0.044	0.47	0.29									
Y.27†	Charge ..	0.068	2.34	0.68	None	—	—	1,360	3.62	5.50	28.04	Coarse graphite, very few non-metallic inclusions	—
	Cast ..	0.058	1.96	0.60									
	Reduction ..	0.010	0.38	0.08									
Y.28	Charge ..	0.068	2.34	0.68	0.9	1,400	9	1,360	3.96	8.23	35.16	Coarse graphite, very few non-metallic inclusions	—
	Cast ..	0.039	1.98	0.56									
	Reduction ..	0.029	0.36	0.12									

* Test-bars 2 in. × 1 in. × 18 in. Broken on 12-in. span. † Blank.

Machine Polishing of Metals.

FUNDAMENTAL FACTORS.

An article in a recent issue of "The Iron Age" on the "Successful Machine Polishing of Metals and Metal Products," based on a Paper on this subject by Mr. B. T. Kent, read at the National Metal Congress, states that many variables (such as the material; condition of the original surface and condition desired in the final surface of the work; the type, material, density and cushion of the polishing wheel; the nature and grain size of the abrasive and the peripheral speed of the polishing wheel; the speed and pressure on wheel and machine vibration) are among the most important factors on which depends the success of machine polishing. It is important to provide oscillation in either the work or the polishing wheel in order to avoid straight-line polishing marks on the surface.

It is difficult, continues the author, to lay down any general rule covering the economics of machine polishing. Nevertheless, where the machine is adapted to the work and hand operations can be eliminated and where there is sufficient production to keep the machine busy a fair proportion of the working day, machine polishing will usually prove economical.

It must be recognised at the outset that all variables are more or less inter-related. For instance, the character of the material will determine the character of abrasive. Then, too, the condition of the original surface influences the size of the abrasive grain that is to be employed. The contour of the work will influence the selection of the type of wheel, as for instance, a plain surface calls for a hard, somewhat rigid wheel. Work that has a curved contour calls for a softer, flexible wheel that will fit itself to the surface to be polished. The degree of finish to be obtained also influences the speed of the work past the polishing wheel—the slower the speed of the work passing the wheel, the better will be the finish. The material of which the work is composed determines the character of the abrasive that must be used.

Requirements of Various Metals.

Steel and brass require sharp cutting edges to be continuously applied to the work. The abrasive, therefore, should fracture in such manner and along such fracture planes, as to form cutting edges that are always of the same character. An abrasive that fractures in such a manner as to cause splinters and slivers will prove unsuitable as these splinters induce scratches in the work. In soft cast iron, the sharp-cutting grains tend to dig the iron particles out of the softer carbon matrix and to roll them along the work under the wheel. A solution is found in the use of an abrasive that will crush instead of fracture it. Alundum is satisfactory on steel and brass, and crystolon may be used for polishing cast iron.

Effect of Mill Scale and Pit Marks.

Mill scale is hard and difficult for the polishing wheel to break. Furthermore, it will clog the wheel and render it ineffective in a short time. Deep pits require that the polishing wheels remove all the surface metal down to the bottom of the deepest pits, and may impose a wholly unnecessary burden on the wheel. Tumbling or pickling may improve both of these adverse conditions but, if not carefully done, may increase the difficulty. The surface may be ground or it may be machine-finished. In either event, the polishing wheel must first remove the metal down to the bottom of the deepest grinding scratch or deepest tool mark.

Wheels should be Trued at Speed Used.

It is an easy matter to make a wheel truly cylindrical when truing it up in the lathe, preparatory to applying abrasive head. However, it should be borne in mind that, in the ordinary wheel-dressing machine or engine lathe, which is sometimes used for the purpose of truing wheels, the speed of rotation is relatively low. When in operation the polishing wheel rotates at from 1,800 to 2,500 r.p.m., depending upon the diameter. The wheel will become distorted at these high speeds, and the surface that comes in contact with the work is no longer cylindrical. To correct this condition, wheels should be trued at the same speed at which they are to be used.

The various buff sections of which the clothflex wheel is composed may be glued together from the centre hole clear out to the circumference of the wheel, or the gluing may stop at 3 in. or 2 in., or any other distance from the circumference, depending upon the hardness of the cushion desired in the wheel.

The polishing machine should be designed, wherever possible, to maintain a constant peripheral speed of the polishing wheel as close as possible to 7,500 lin. ft. per min. In general the higher the peripheral speed, the more efficient is the action of the abrasive. The figure of 7,500 ft. is chosen because this speed is about the maximum at which the glue holding the abrasive to the surface of the wheel will maintain its strength under the action of the heat generated by the operation of the wheel upon the work.

The polishing wheel, when correctly built and properly maintained, should not decrease appreciably in diameter with use. The wheel should never be operated after the abrasive head has been worn through to the fabric of which the wheel is composed. In setting up the wheel a protective head of glue should be placed on it before the glue that holds the abrasive is applied. As soon as the wheel wears down to this particular head, it should be removed from service, the old abrasive removed, and a new head applied.

Speed Depends on Two Factors.

Speed of the work past the wheel depends on the material of which the work is composed and the degree of finish required. It varies between wide limits; about 15 ft. per min. is a high rate of speed for rustless steel. It frequently happens that the polishing machine has a capacity of from 200 to 300 pieces of given size and shape per minute, but it is manifestly beyond the ability of an operator to feed work at this rate, particularly where the work must be more or less accurately placed in work-holding fixtures. It sometimes is possible to arrange machines so that two or three operators can load it, the unloading being taken care of by an equal number of operators, or automatically.

Excessive pressure greatly increases the operating cost, as it wastes grain, glue and labour for the setting up of wheels, and it also requires more operations on the work, due to the inefficiency of highly-heated wheels. In most cases of machine polishing, particularly in straight line work, it is desirable to approximate the effect of applying the work to the wheels at varying angles by either moving the wheel or work transversely to the line of travel to the work past the wheel. In some classes of work it may be desirable to divide the cushion required for flexible grinding between the wheel and the work. The wheel is made of proper density and cushion to give the desired finish, and a cushion surface is also provided under the work to enable it to yield sufficiently to overcome slight variation in contour that would cause the wheel to cut deeper, were the work not able to recede somewhat from the wheel.

Common Causes of Vibration.

Vibration in the polishing machine produces the same evil effects as it does in any other kind of a machine except that these effects are magnified due to the very nature of the work that the machine is called upon to do. The more common causes of vibration are: Inadequate machine foundation, improperly or lightly-constructed buildings, light floors, machines being improperly located on upper floors, insufficient weight in machine bases, shafts too light, or with bearings too far apart giving them a tendency to whip at high speeds, insufficient bearing surfaces, improperly-braced machine members, or members whose vibration period corresponds to some recurrent motion in some moving part of the machine, and unbalanced polishing wheels.

French Foundrymen's Congress.

The 10th annual convention of the Association Technique de Fonderie will be held on May 20 and 21 at the Ecole Nationale d'Arts et Métiers, 151, Boulevard de l'Hôpital, Paris, under the presidency of Mr. J. Cury. Members of the Institute of British Foundrymen are specially invited to be present, and participants should, if possible, notify the secretary of the Association at his office, 20, rue Richer, Paris.

Programme.

Wednesday, May 20.

9 a.m.—Registration of members.

10 a.m.—Opening addresses; presentation and discussion of the following Papers:—"A Few Remarks concerning Mechanical Tests for Cast Iron," by Prof. A. Portevin (President of the International Commission for New Methods of Testing Cast Iron); "Training Skilled Moulders," by Mr. Hiernaux (director of Charleroi Special University); followed by a general discussion on the training of foundry personnel.

3 p.m.—"The Casting of Flywheels," by a Committee of the Belgian Foundrymen's Association; "Contraction in Grey-Iron Castings" (permanent and elastic deformation whilst hot), by Mr. M. Girault; "Scabs and Cracks," by Mr. Gasquard, of the Société Française de Construction (Babcock & Wilcox); "Some Notes on Prints," by Mr. V. Marteil, of the Ecole Nationale d'Arts et Métiers.

Thursday, May 21.

9 a.m.—"Controlling the Casting Temperature of Non-Ferrous Alloys," by Mr. St. Johns, of the Detroit Tube Company (American Exchange Paper); "Reservoir Furnaces for the Aluminium Foundry," by Mr. Pierre Girod; "Factors of Safety in Castings" (the part played by the occult factors of instability of manufacture—examples from light-alloy practice, but not peculiar to them), by Mr. R. de Fleury; "Some Notes on the Brasses," by Mr. Moustacas and Mr. Merle, of the Copper and Bronze Foundry Owners' Federation.

3 p.m.—"Special Steels," by Mr. Flour, of the Aciéries Edgar Allen; "Enamelling Grey-Iron Castings," by Mr. J. H. D. Bradshaw, of Messrs. Bradley & Foster, Limited (British Exchange Paper); Report by the French Committee on "Methods of Testing Grey Iron," presented qby Mr. F. Nicolau.

7.30 p.m.—Annual dinner, to be held at the Hotel Palais d'Orsay, 9, Quai d'Orsay, followed by a dance organised by the Paris Foundry High School Old Students' Association.

The Tees-side Bridge & Engineering Works, Limited, Middlesbrough, has secured an order for 1,600 tons of steel for a series of steel tanks to be constructed for Messrs. Cory Bros. & Company, Limited, at Thames Haven.

Steel Sleepers.

A BRITISH INDUSTRY OF HALF-A-CENTURY.

In the course of a Paper on "Steel Sleepers—Past and Present," read on April 13 by Mr. T. P. Cargill before the Cleveland Institution of Engineers at Middlesbrough, he pointed out that for many years steel manufacturers sought to interest British railways in the use of steel sleepers, but without success. About two years ago a combination of circumstances, partly political, brought the subject to the forefront and forced the British railway boards to give much more serious consideration to the subject than they had done during the last fifty years. The amalgamation of the various railways perhaps made the approach less difficult than before but, in any case, the efforts of the sleeper manufacturers led to a series of conferences at which many designs of steel sleepers were submitted to, and considered by, a joint board comprising all the chief engineers of the several railway groups.

At the conferences between the railway engineers and the sleeper manufacturers, the author was at times astonished at how little seemed to be known regarding the development and use of steel sleepers on foreign and Colonial railways. He was afraid that the same lack of knowledge existed even in that district, and that the extent to which Tees-side had contributed to the development of foreign and Colonial railways, by the manufacture of steel sleepers, was neither generally known nor appreciated.

Two firms in that district had been actively engaged in the manufacture of transverse sleepers of wrought iron and steel since the 'eighties, about the time when sleepers of that type were first manufactured in this country in large quantities. He referred to Messrs. Bolckow, Vaughan & Company, Limited, who commenced manufacture of steel sleepers in 1887, and to the Anderston Foundry Company, Limited, whose first contract for wrought iron sleepers was shipped in 1882.

Cast-Iron Bowl Sleepers.

The latter firm established a branch works at Port Clarence, Middlesbrough, during 1875, and for at least 45 years previously had been very actively engaged in the manufacture of cast-iron railway chairs and cast-iron bowl sleepers at their works in Glasgow.

The early railways in Argentina and other South American countries were laid in cast-iron bowl sleepers, and which also became the standard type used by several of the more important railways in India. To show the extent to which cast-iron bowl sleepers were used, the author said it was of interest to note that since 1875 the foundries at Port Clarence produced over 23 million cast-iron sleepers of various kinds amounting to over 970,000 tons. During the same period Messrs. Head, Wrightson & Company, Limited, of Thornaby, also produced immense quantities, and the output of cast-iron sleepers on Tees-side alone during the last 55 years could not have been far short of 2,000,000 tons.

Wrought-Iron Sleepers.

These cast-iron bowl sleepers were relatively heavy, and endeavours were made during the early 'seventies to introduce a form of bowl sleeper pressed from wrought-iron plates. Many tens of thousands of these were made at the Glasgow works of the Anderston Foundry Company, Limited, before that branch of business was removed to Port Clarence and, for a few years after 1875, these continued to be made at Port Clarence but in diminishing numbers, being gradually displaced by the introduction of transverse sleepers, first made from wrought-iron plates and latterly from mild-steel plates.

The first contract for transverse sleepers put through at Port Clarence was dated March, 1882 (49 years ago), and was for 50,000 wrought-iron transverse sleepers, and 54,000 wrought-iron pressed bowl sleepers, for the Cape Government Railways, South Africa. It is safe to assume, therefore, that the manufacture of the present form of transverse sleeper, by mass production methods, commenced in this country about 50 years ago. Between 1882 and the present time the Anderston Foundry Company, Limited, have manufactured close on 17,000,000 transverse sleepers in wrought iron or steel amounting to approximately 510,000 tons.

Although the author had been unable to obtain definite information as to the total tonnage produced by Messrs. Bolckow, Vaughan & Company, Limited, the records to which he had had access led him to believe that their output would be very much similar to that of the Anderston Foundry Company, Limited, during the last 45 years. It would appear, therefore, that during the last 48 years the total tonnage of wrought-iron and steel sleepers produced in the Middlesbrough area cannot have been far short of 1,000,000 tons.

Use of Metal Sleepers Abroad.

By means of lantern slides the author proceeded to describe numerous metal sleepers. He mentioned that the development of the railway systems in India, Argentine and other South American countries, in South Africa and other British dependencies being in these early years almost exclusively in the hands of British railway engineers and financed by British capital, proceeded on somewhat conservative lines. In countries where timber was scarce or climatic conditions unsuitable, cast-iron pot or plate sleepers were generally used, and it was not until 1882 that the pressed transverse sleeper began to be used in ever-increasing quantities.

It would appear that the British development of the present type of steel sleeper proceeded at a much slower rate than that of Continental railways. This might have been due to the fact that railway development in the countries referred to, was entrusted to a relatively few eminent consulting engineers, each probably feeling his way and naturally not too ready to adopt ideas departing from his own practice and experience. But it was a fact that the use of wrought-iron and steel sleepers on Continental railways had developed much more rapidly. It was on record that the first metal transverse sleeper was tried in France in 1860, and that the first really successful type was first used in 1864 on the Paris-Lyons and Mediterranean Railway.

During 1865 the Netherlands State Railways put down a large number of sleepers known as the "Cosjins" type. The sleeper consisted of an 8-in. rolled joist laid on its flat, having two oak blocks bolted on and grooved on the top surface to receive the flange of the rail. The rail was secured by bolts or screws.

The "Boyenval-Ponsard" sleeper, made from a rolled double-trough section and with cast-iron chairs bolted on, and used by the State Railways of France, was first made in 1887, whilst the "Paulet-Lavallette" sleeper, made up from two angles with cast-iron chairs bolted between the angles, to receive either bull-head or flanged rails, appears to have been first tried during 1885, but was displaced by the "Vautherin" type, which was much less expensive and less liable to damage. It was found that the flanges on the lower edges of the "Vautherin" type were objectionable, as they prevented the sleeper from settling down on the ballast. The trough was very similar in section to sleeper troughs rolled at the present time on the Continent.

The Belgian railways experimented with cast-iron sleepers as early as 1846, and appear to have tried at one time or another every conceivable type. German and Austrian railways made extensive trials of longitudinal rolled sleepers. In some cases the rails were made in two sections with a very wide flange and riveted together. The latest sleeper adopted as standard by the German Railway Board has been designed for silent running. There was now a bearing plate welded to the sleeper body. Each plate had two upstanding ribs. After welding the plates in position, the ribs were milled from the solid to form a slot of the shape to receive clamping bolts with specially-shaped heads. The clamps were of cupped shape and straddle over the ribs. The side thrust on the rail was received by one of the ribs.

Trials of Steel Sleepers on British Railways.

Continuing, the author said that Webb's sleepers, consisting of a plain rolled trough of the original "Vautherin" section, the rail being carried in chairs made in three pieces of steel, rolled and stamped to shape and riveted to the sleeper body, were first laid down in 1880, and by 1889 over 100,000 were in use on the L. & N.W. system. The ends of the sleepers were left open. Although these sleepers proved generally satisfactory in service the L. & N.W. Railway did not continue development on these lines.

The Midland Railway experimented in 1885 with 250 tons of "Vautherin" trough sleepers, made at the Cockerill Works, Belgium, the ends being pressed down. The chairs were bolted by twin bolts. The North Eastern Railway experimented with several types, including a steel sleeper made at the Eston Works of Messrs. Bolckow, Vaughan & Company, Limited. The records showed that manufacture commenced in 1887 and continued for a few months only. This sleeper was patented by the late Mr. James Riley. The sleeper, with its two chairs, was pressed from one plate. Mr. Riley was obviously before his time with this design, for the author understood that one of the South Wales firms had recently submitted a very similar design to the Railway Board in London.

Sleeper Suitable for Mass Production.

For several years before the amalgamation of the railways the Anderston Foundry Company, Limited, endeavoured to interest the North Eastern Railway in the use of steel sleepers for bull-headed rails. Being one of the earliest manufacturers of steel sleepers in this country, this firm were not without knowledge of the conditions to be met, and had extensive experience of the behaviour of various types under actual traffic conditions and in all kinds of climatic conditions on railways abroad. They submitted this design in December, 1924, to the North Eastern Railway, and again two years ago to a board of chief engineers of British railways who had invited designs for sleepers suitable for conditions in this country.

The design embodied the old "Tozer swivelling chair." The conditions which influenced the adoption of this design were the following: (1) In order to compete in price with the usual timber sleeper, a steel sleeper for British railways must be capable of being manufactured by mass-production methods, with no break or stop in the process of manufacture from the first heating of the plate to the stacking of the finished sleeper, dipped and ready for delivery.

(2) The rail gauge must be accurate within the usual limits, and preferably should be capable of being widened when required. The design should be such that any sleeper manufacturer with his present plant could produce the sleeper, for it was most unlikely that the British railway companies would, if they proposed to adopt steel sleepers in future in preference to timber sleepers, develop on such lines as would tie them to one maker, or at least make it difficult for other makers to compete.

(3) The sleeper should be without perforations from which cracks or fractures were likely to

extend and cause failure. (4) Loose parts should be avoided or reduced to an irreducible minimum. (5) The rail to be secured by the usual oak key, than which no better fastening had yet been found to meet Britain's changeable climatic conditions. (6) The whole design should be such that in case of derailment, damaged sleepers could be readily repaired and not necessarily by the original manufacturers. The author stated, however, that the design had not as yet found favour with the British railway engineers.

The Steel Industry and Steel Sleepers.

The trials now being made with steel sleepers on British railways, concluded the author, were of great interest to the steel industry to-day. Naturally, such trials must be continued over a somewhat lengthy period before the railway engineers could express a favourable opinion, but it was to be hoped that the results would lead to the adoption of steel sleepers in ever-increasing numbers. The railway engineers in this country, by imposing certain conditions which manufacturers must meet, had not made it any easier for the latter. At present the preference of the engineers seemed to lie in a one-piece sleeper having no perforations; for example, that of Messrs. Guest, Keen & Nettlefolds, Limited, having two chairs cast on, and also those other designs having rolled- or pressed-steel chairs, seam-welded to the body of the sleeper.

It must not be forgotten that in the period between 1880 and 1885 the various railway companies in this country showed the same interest in this subject as they were doing to-day, and in that respect history was but repeating itself. Let it be hoped, therefore, that instead of steel sleepers being discarded by British railway companies, as they were in 1887 or 1888, they would be used in ever-increasing quantities. It was, however, fairly obvious that unless a satisfactory steel sleeper to meet the requirements of British railway engineers could be produced at prices reasonably comparable with those paid for timber sleepers, there would be little chance of steel sleepers being adopted as the standard for track construction in this country.

American Pig-Iron Output in 1930.

The official figures issued by the American Iron and Steel Institute show that the output of pig-iron in the United States in 1930 totalled 31,020,907 tons of 2,240 lbs. (as against 41,757,215 in 1929), and of ferro-alloys 731,262 (856,768) tons. Of last year's output 18,393,384 (24,911,654) tons were basic iron, 7,314,749 (9,877,240) tons were Bessemer and low-phosphorus iron, 3,622,779 (4,446,011) tons foundry iron, 1,571,512 (2,312,813) tons malleable iron, 50,696 (167,930) tons were forge iron, and 67,787 (41,567) tons were other kinds of pig-iron. Of the ferro-alloys 362,386 (476,655) tons were ferro-manganese and spiegel, 337,640 (341,222) tons were ferro-silicon, and 31,236 (38,891) tons were other kinds of ferro-alloys.

On December 31, 1930, there were 90 furnaces in blast in the United States out of a total of 283 (as against 155 in blast on June 30, 1930). Of last year's output, 30,924,327 tons were coke pig-iron and 96,580 tons were charcoal iron. Of the pig-iron output, 6,567,419 tons were for sale and 24,453,488 tons for the makers' own use. Of the ferro-alloy output, 216,046 tons were for the makers' own use and 515,216 tons were for sale.

The Brightside Foundry & Engineering Company, Limited, Sheffield, has completed for a Spanish steelworks, which specialises in the rolling of large sections and joists for constructional purposes, the manufacture of an electrically-equipped rolling mill with all requisite equipment.

Publication Received.

Famous Men and Carron Works.—Another of the series of pamphlets dealing with famous men who were connected with the early history of Carron Company has just been issued, and narrates the association with Carron Company of James Bruce, of Kinnaird, the famous Abyssinian traveller. For nearly 170 years, the brochure states, the Kinnaird mineral field in Stirlingshire has been leased and worked by Carron Company as colliery owners, and it is interesting to record that the first lease in this long connection was entered into on November 12, 1760, by the company with James Bruce, the famous Abyssinian traveller. Included in the subjects leased were the "coal hewers, coal bearers, banksmen, gatesmen and others bound to the works conform to an Inventory to be made up and signed by both parties." It may not be generally known that previous to 1775 all the hewers and coal bearers connected with the collieries were held in bondage as serfs, and were actually transferable with the pits to which they were attached. An Emancipatory Act was passed in 1775, but on account of the vagueness of certain of the conditions it did not serve the purpose for which it was intended, and not until 1779 were colliers completely relieved from their servitude. Until well into the nineteenth century miners were accompanied underground by their wives and daughters, and the Eve of the time accepted occupation in the pit as the usual means by which she could earn an honest living.

James Bruce was born at Kinnaird House, Stirlingshire, on December 14, 1730, and on his father's death in 1758 he succeeded to the estate. In June, 1768, he proceeded to Alexandria, and from Cairo set out on his historic journey to Abyssinia, which forms an epoch in the annals of discovery. The fountains of the Nile were discovered by him in 1770. Bruce was a distinguished linguist, and is said to have been able to converse in as many as thirteen languages. His death occurred at Kinnaird on April 27, 1794, and was occasioned by a fall downstairs. A monument erected to his memory, manufactured, it may be remarked, by Carron Company, is to be seen in Larbert Churchyard. The monument bears the following inscription:—

"In this Tomb are Deposited the Remains
Of James Bruce, Esqr., of Kinnaird,
Who Died on the 27th of April, 1794,
In the 64th Year of his Age.

His Life was Spent in Performing
Useful and Splendid Actions.
He Explored Many Distant Regions.
He Discovered the Fountains of the Nile.
He traversed the Deserts of Nubia.

He was an Affectionate Husband,
An Indulgent Parent,
An Ardent Lover of his Country.
By the Unanimous Voice of Mankind
His Name is Enrolled with those
Who were Conspicuous
For Genius, for Valour, and for Virtue."

It is also interesting to note that the monument was designed by one of the Brothers Haworth, the celebrated artists, who executed many carvings for Carron Company, numerous reproductions of which are incorporated in Carron firegrates.

Over 40 trade unions in the engineering industry were represented at a conference held in London recently to discuss the position arising out of the proposals of the engineering employers for a revision of working conditions. The employers have asked the unions to co-operate with them in an effort to meet competition, and have made certain proposals for a modification of working conditions. They have intimated that, if these proposals are not accepted, it may be necessary to suggest the alternative of a direct reduction in wage rates. The unions expressed strong opposition to the proposals, but agreed to the appointment of a committee of investigation to examine the suggestions in detail.

World Production of Pig-Iron and Steel.

PRELIMINARY FIGURES FOR 1930.

We have received from the National Federation of Iron and Steel Manufacturers, the accompanying table, giving the estimated world output of pig-iron and steel, with figures for the principal producing countries in 1929 and 1930:—

Estimated World Production of Pig Iron and Steel, 1929 and 1930.

	1929.	1930.
Pig-Iron:	(In millions of tons.)	
United Kingdom	7.59	6.20
Germany	13.19	9.54
France	10.20	9.94
Belgium	4.03	3.35
Luxemburg	2.86	2.44
Saar	2.07	1.88
Russia	4.24	4.92
Poland	0.69	0.47
Italy	0.71	0.53
United States	42.61	31.40
Canada	1.16	0.81
Other countries	7.88	7.17
Total	97.23	78.65
Steel Ingots and Castings:		
United Kingdom	9.64	7.30
Germany	15.99	11.36
France	9.55	9.27
Belgium	4.07	3.32
Luxemburg	2.66	2.23
Saar	2.17	1.91
Russia	4.76	5.59
Poland	1.36	1.22
Italy	2.11	1.75
United States	56.43	41.20
Canada	1.39	1.00
Other countries	8.30	7.05
Total	118.43	93.20

Cupola Practice.

Mr. N. D. Ridsdale stepped into the breach at a recent meeting of the Middlesbrough Branch of the Institute of British Foundrymen, the lecturer at which was to have been the late Mr. W. H. Poole. Mr. Ridsdale chose for his subject that of cupola practice, and, although his notes had perforce been hastily assembled, they formed an interesting and instructive lecture. Mr. F. P. Wilson, J.P., President of the Institute, presided.

Mr. Ridsdale, at the outset, said that gas analysis could reveal a number of evils. From it could be deduced whether there was too much or too little blast and whether the coke charges were suitable in size. Analysis could also indicate whether the charging was regular or the coke too soft. He said that gas analysis should be conducted in conjunction with volume measurements of the blast, and then dealt with some of the difficulties of taking these analyses. He emphasised the importance of analysing cupola slag; a low lime produced a sticky slag which might cause bridging. Some 18 to 25 per cent. of lime gave fluid slag, and facilitated a slight sulphur removal without appreciably attacking the cupola lining. Touching upon the question of single or double rows of tuyeres in the cupola, he said that the double row gave better results, and there was less tendency to bridging.

In reply to a member's inquiry, Mr. Ridsdale said that, in his opinion, good firebrick bases were better than cast-iron bases for cupolas, although he admitted there was room for improvement in the quality of the firebrick. Mr. Ridsdale was then cordially thanked for his lecture.

The Determination of Manganese in Ferro-Silicons by the Volumetric Method.

By J. H. D. Bradshaw.

The determination by the well-known basic acetate method of small quantities of manganese in the presence of much iron is a lengthy and troublesome process, principally on account of the large volume of liquid to be boiled and filtered. Where accuracy is desired, the operation has to be repeated, as invariably some of the manganese is precipitated along with the iron. In addition, an assistant or student frequently fails to effect complete precipitation of the iron, or obtains it in such a condition that filtration is very difficult. On account of these disadvantages, the process has been largely replaced by more rapid and simple persulphate and bismuthate methods. Each of these methods, however, depends on the solubility of the sample in nitric acid, and, owing to the insolubility of ferro-silicons in nitric acid, a modification becomes necessary. The following has been found to give excellent results with low-grade samples (*e.g.*, below 18 per cent. silicon).

Method.

Exactly 0.5 gramme of the finely-powdered sample is placed into a 250-c.c. tall beaker. Then 30 c.c. hydrochloric, 15 c.c. nitric and 5 c.c. sulphuric acids are added (the latter cautiously), and the beaker placed on a moderately hot plate. Solution is effected and evaporation allowed to proceed until sulphuric fumes are freely evolved. Silica will then be deposited; the beaker should be removed from the plate, and the solution allowed to cool. The solution is now diluted with a little water, brought to the boil to dissolve all soluble matter, and the silica, etc., removed by filtration. The filtrate is collected in a 50-c.c. flask, and the volume made up with water. Usually, however, the volume of liquid obtained is above 50 c.c., in which case the filtrate must be collected in a beaker and the volume reduced by evaporation.

Silicon may be estimated by thorough washing and ignition of the precipitate, weighing the silica obtained. This weight × 94.04 = the percentage of silicon in the sample. The manganese is determined on a portion of the filtered solution. Ten c.c. (= 0.1 gramme sample) of the solution is withdrawn from the flask and transferred to a 200-c.c. conical flask. Add 3 c.c. of 1.2 sp. gr. nitric acid, place on the hot plate and bring to boil. Ten c.c. of silver nitrate solution (4 grammes $AgNO_3$ per 1,000 c.c. H_2O) are added, and at the boiling point 20 c.c. of a 20-per-cent. solution of ammonium persulphate added. The flask is allowed to remain on the plate for exactly one minute, during which time permanganic acid is formed, and imparts its red colour to the solution. The solution is now cooled very rapidly under running water, and, when cold, immediately titrated with sodium-arsenite solution until the pink colour is discharged. The number of c.c. sodium arsenite required × factor = per cent. of manganese.

The sodium-arsenite solution is prepared by boiling 10 grammes of arsenious acid until dissolved, in an aqueous solution of 30 grammes of sodium carbonate and diluting to a litre. About 33 c.c. of this stock solution is diluted to 1,000 c.c. This working solution is standardised on steels or pig-irons of known manganese content, and an empirical factor obtained. It is, however, a decided advantage to make the necessary adjustments to this solution so that 1 c.c. equals 0.1 per cent. manganese on 0.1-gramme sample. By so doing, calculation is eliminated, and results are obtained more rapidly.

Instead of using solutions as mentioned, the "Analoid" system may be adopted, and, in fact, has been found to give excellent results. Owing to the smaller volume of liquid when working this method, however, a 7-in. by 1-in. test-tube may be substituted for the flask. This is placed in a vessel (*e.g.*, beaker) of boiling water or a "carbon boiler."

Remarks.

Hydrochloric acid (chlorides) must be absent from the hot solution of manganous salt to which silver nitrate is added, followed by ammonium persulphate. Although hydrochloric acid is used for dissolving the sample, it is expelled by the sulphuric acid, prior to removal of silica. Ammonium persulphate causes the formation of permanganic acid by oxidation of the manganese nitrate. The silver salt merely acts as a catalyst, and without it manganous acid H_2MnO_3 is precipitated.

Under the conditions which usually prevail, the manganese of the permanganate is not reduced to a colourless manganese salt by the sodium arsenite. In other words, the reaction does not correspond exactly with the equation:

$$H_2 Mn_2 O_{_} + 5 Na_3 As O_3 + 4 H N O_3 = 2 Mn (NO_3)_2 + 5 Na_1 As O_4 + 3 H_2O.$$

The arsenite solution must, therefore, be standardised in exactly the same way as it is used in the analysis, and an empirical factor used. Should a precipitate of hydrated manganese dioxide form on the addition of ammonium persulphate, the solution must be discarded, and a fresh start made employing a smaller sample. To obtain a good end-point, it is necessary to add 2 c.c. of sodium-chloride solution (12 grammes NaCl per 1,000 c.c. H_2O). This precipitates the silver as chlorides:

$$AgNO_3 + NaCl = NaNO_3 + AgCl.$$

The remaining persulphates are prevented from exercising a slight re-oxidising influence, and the titration is rendered more accurate by preventing the recurrence of the end-point.

Comparison of Results.

From the point of view of both time and simplicity of operation, there is much to commend the process outlined above. Silicon and manganese can be determined in two hours, whilst manganese alone may be estimated in about one and a-half hours. The results obtained agree very closely with those obtained by longer methods, as shown in Table I:—

Table I.

Truck No.	Silicon.	Manganese.	
		Sodium Arsenite.	Basic Acetate.
10,680	10.44	1.55	1.58
324,948	12.59	1.30	1.33
529,028	15.50	1.56	1.58
624,022	10.15	1.31	1.32
32,645	9.76	1.70	1.74
81,621	10.24	1.89	1.89

Higher-Grade Materials.

Ferro-silicons containing over 18 per cent. silicon are best dealt with by treatment with fusion mixture, and fused in a nickel capsule. After fusion—which need only last half an hour at 900 deg. C.—and cooling, the "melt" is softened and removed from the capsule by means of boiling water. Acids are then added, as in the case of the lower-grade materials. From this point, the process for the estimation of both silicon and manganese is identical with that outlined earlier. The writer wishes to place on record his thanks to the directors of Messrs. Bradley & Foster, Limited, for their permission to publish these results.

Japanese iron and steel manufacturers are contemplating setting up a national selling scheme, including both Government and private works. This step, which is an alternative to amalgamating the various works—a project which has failed to materialise—is being considered by a special committee set up for the purpose.

Firebrickmaker's Views of Trade Outlook.

Speaking at the annual reunion of Messrs. John G. Stein & Company, Limited, Bonnybridge, Colonel Alan Stein said that, though the firm had been very successful in the past in providing regular work to steadily increasing numbers, they had had to curtail slightly their output during the past six months. Notwithstanding this, they had as many employees as they had last year, but since then they had started the new works at Manuel. Referring to the general situation, he said he was once told by a distinguished research worker that "A problem well defined is half solved." There were important factors, such as the state of affairs in Russia, India and China, and the world depression in trade, but the main problem was to get costs of production reduced. Britain was handicapped with high wages in many of the sheltered trades, by this is meant those trades not competing for export. The municipal street cleaner received a higher wage than the skilled engineer.

There were two principal ways by which costs could be reduced, leaving aside an extension of piecework, for which there appears room especially in the building trade. First, expenditure of more capital on improved plant and equipment to get greater production per head; second, reduction in wages rates. The first way, in his opinion, was the desirable way, but, apart from lack of confidence in the future, we in this country were using up our capital in excessive taxation, and it was not available for new equipment and new construction. The provision of new equipment in itself provides considerable employment. For example, his firm had been spending capital for two years building new works at Manuel, and, roughly speaking, gave employment, directly or indirectly, to 350 men during those two years, and now when complete it was giving regular employment to others. The ultimate interests of both capital and labour ran more on parallel lines than was generally believed, and a proper realisation of economic laws would help everybody to recover more quickly from the present depression.

Iron and Steel in Mexico.

The Department of Overseas Trade has issued a Report* on "Economic Conditions in Mexico" (January, 1931) by Mr. E. A. Cleugh (Acting British Consul-General, Mexico City).

Regarding the iron and steel industry, the Report says that there has been a gradual expansion of this industry in Mexico in recent years, and material assistance has been given by the Government by means of tariff protection. The principal company engaged is the Monterrey Iron & Steel Works, which is the only company in Mexico controlling its own mines. In 1929 this company produced 60,230 metric tons of pig-iron, 100,084 tons of steel and 84,139 tons of rolled products. The production in 1930 did not reach these figures.

In 1929, Mexico imported 112,790 metric tons of iron and steel products, of which 9,927 tons represent products not manufactured locally and the remainder, 20,863 tons, competing products. Consumption is rising steadily and should offer opportunities to British manufacturers. Germany supplies considerable quantities of wire and wire netting, steel plates, tubing and enamelled ware. As regards railway material, most of the rails and other track materials are produced in the country, but steel cross-ties are imported largely from Germany and Belgium. Great Britain's chief share in the trade is in galvanised sheets, but a Mexican firm has recently installed galvanising equipment.

* H.M. Stationery Office, Adastral House, Kingsway, London, W.C.2. (Price 1s. 6d., post free 1s. 7d.)

Nitriding of Iron and Iron Alloys.

In a recent issue of "Archiv für das Eisenhüttenwesen," Messrs. Walter Eilender and Oskar Meyer give the results of experiments carried out with electrolytic iron, four carbon steels (containing 0.06, 0.54, 0.82 and 1.40 per cent. C respectively), and various alloy steels prepared from Armco iron. Their object was to investigate the surface hardness and the structure of the nitrided alloys, the added metals being chosen partly because they are constituents of the common nitriding steels, and also because their nitrides are comparatively stable. These alloying metals (with their maximum proportions) were: Chromium (14.15 per cent.), molybdenum (8.16 per cent.), aluminium (7.50 per cent.) and vanadium (3.0 per cent.).

The test-pieces were nitrided in a stream of dry ammonia gas at constant temperature and rate of gas flow, the surface hardness and that of the interior being measured on oblique sections. The sections for micro-examination were etched with picric acid for 2 min., this being found to give the best results. Hardness was measured by the Rockwell machine and the Herbert pendulum machine.

The electrolytic iron was heated for 12 hrs. in the dry ammonia-gas streams at temperatures from 200 to 1,000 deg. C. Micro-examination showed penetration of nitrogen at the surface at 300 deg. C. The depth of the nitride needles, corresponding to an end concentration of about 0.015 per cent. N, was taken as a measure of the nitrogen penetration. This was found to increase to a maximum at a temperature of about 680 deg. C., falling to a minimum at about 800 deg. C. due to the decomposition of the surface layers, and rising again at temperatures above 900 deg. C. The testing of the surface hardness gave very variable results, on account of the poor nature of the nitrided layers, but in spite of this it was definitely established that the hardness increased with the temperature of treatment. At nitriding temperatures below 600 deg. C. there were always only two distinct layers, a dark granular outer one and a narrow bright-etched inner one which joined on to the core containing separated nitride needles. Above 600 deg. C. there was also apparent the eutectoid. No trace of other layers could be found.

The variation of the depth of the penetration of the nitride needles with the temperature and duration of treatment permitted the calculation of the speed of diffusion, which at 450 to 600 deg. C. was found to be 2.14 by 10_{-8} cm. per sec. The diffusion of nitrogen appeared to be not appreciably different, either as regards its nature or speed, from that of carbon in iron.

The carbon steels were nitrided at 550 deg. C. for periods of 6, 9, 12, 24, 36 and 48 hrs. These showed the same outer layers with nitride needles in the core, the depth of both increasing with the period of treatment. With 0.06 per cent. carbon the depth of the outer layers was about 10 per cent. of the total penetration. The effect of higher carbon content was to increase the relative depth of these outer layers (to about 50 per cent. with 1.40 per cent. carbon), while decreasing the total penetration (which at 30 hrs. was only about 40 per cent. with the highest carbon content, of that with the 0.06 per cent. carbon steel). It was found that the hardness of the surface first rose with the time of heating, but fell slowly away when this exceeded 24 to 30 hrs.

The experiments with the alloy steels showed that the surface hardness did not increase when the concentration of the alloying elements exceeded certain definite proportions, falling considerably in the case of the iron-chromium alloys after passing 2.5 per cent. chromium. The greatest hardness was obtained with the iron-aluminium alloy, the corresponding aluminium content being given in the text as 1 per cent., although the diagram shows slightly over 2 per cent. In general the best proportions found for the alloying metals agree with those used in practice. The structure with low percentages of metallic additions are similar to those found with electrolytic iron and carbon steels, but considerable differences occur with higher concentrations. Thus with the iron-aluminium alloys there was no separation of the nitride needles and the outer layer became narrow, giving place to a broad band, reminiscent of the separation of colloids.

The nitride-hardening of these alloy steels is irreversible.

Permanent Growth of Grey Cast Iron.

The American Institute of Mining and Metallurgical Engineers has published technical publication No. 337 (Class C, Iron and Steel, No. 55), by Mr. W. E. Remmers, on "The Permanent Growth of Grey Cast Iron." The following is the author's summary and conclusion.

The phenomenon of irreversible growth of grey cast iron can be described as a result of:

(1) Precipitation, solution and reprecipitation of graphite in the solid matrix material. Ordinarily this effect is predominant in the growth obtained on the first heating after casting.

(2) Oxidation of the matrix material after the graphite flakes have been burned out. This reaction has a large accelerating effect on growth.

(3) Mechanical swelling created by finely fracturing the slightly ductile structure of grey cast iron. This fracturing is most effective on passing through the A_1 transformation both on heating and cooling.

All alloying elements, such as silicon, aluminium and under certain conditions titanium and nickel, which favour the precipitation of carbon, tend to increase growth, while elements such as chromium and manganese, which exert a stabilising effect on the carbon, tend to decrease growth. Increase in total carbon also increases the growth. Vanadium, even though much less effective than the other precipitating elements, favours growth. Chromium, either alone or in the presence of vanadium or nickel, effects a retarded growth, particularly if the nickel is replacing some of the silicon in the cast iron.

The foregoing summary indicates that in order to minimise growth, the cast iron should be as near to a white iron condition as is practicable for the particular casting. Alloy cast irons, such as chrome-nickel or chrome-vanadium, produce a smaller amount of growth. With this as a preliminary step the castings should further be protected from excessive oxidation where possible and the temperature changes should be gradual.

Iron and Steel Output in March.

The National Federation of Iron and Steel Manufacturers report that the number of blast furnaces in operation at the end of March was 81, the same number as at the beginning of the month, three furnaces having ceased operations and the same number having commenced. The production of pig-iron amounted to 357,100 tons compared with 318,200 tons in February, or practically the same daily rate. Production in March, 1930, had been 665,800 tons. The production in March, 1931, included 95,600 tons of hematite, 131,200 tons of basic, 100,800 tons of foundry and 16,100 tons of forge iron. The March output of steel ingots and castings amounted to 500,100 tons compared with 486,400 tons last February and 826,100 tons in March, 1930.

Disappointing Spelter.

By "Onlooker."

Disappointment is perhaps hardly an adequate word with which to describe the tragic setbacks seen in the values of every member of the non-ferrous group, but for sheer despair and heart-break it is perhaps difficult to beat the outlook in zinc. Tin and copper have their curtailment programmes and associations of producers to help them, while there is always the hope that lead may recover again when quota difficulties are composed, but since the collapse of the Zinc Cartel spelter seems to have drifted like a ship without a rudder. From time to time a brief burst of optimism seems to supervene, but only too often this proves to be merely an improvement in sentiment, engendered by a better tone in other metals.

At the beginning of this year it will be remembered the London market listed spelter at just below £14, but before the end of March it had dropped down to £11, and thus set up an unprecedented low record. Rallies have followed, one or two fairly strong and others obviously doomed to failure before they were fairly begun, but at the time of writing cash spelter stands at £11 7s. 6d., and the outlook is just about as gloomy as it can be. For a long time past trade buying has been on a very small scale, for neither the galvanisers nor the brass foundries seem to have orders in any quantity to cover, and arrivals in this country are such as to keep up a steady selling pressure on the London market. Stocks in official warehouses have risen to some 13,000 tons, and although users may not be holding burdensome reserves, they are, nevertheless, very shy of putting more metal on their books. After all, why should they? Of a rise in values there appears to be little or no likelihood, while it is certainly just possible that the £11 limit may be broken before trade picks up sufficiently to turn the market in an upward direction.

When, after protracted negotiations, it was finally decided to abandon hope of reconstructing the Cartel, there was some suggestion that output curtailment would accrue rapidly, since those producers who had held up their programme of restricted production would then realise that all idea of help from group action must be abandoned. Probably this has happened to some extent, but so top heavy was the situation by the time the Cartel fell through, and so poor has trade demand been since, that the small amount of curtailment achieved has not made itself felt to any great degree. Wrapped up as it is in other processes, the output of zinc is bound to continue on a fairly generous scale whatever happens, and as far as Australia is concerned, there has been, and is, every incentive to the export of spelter and zinc concentrates to Europe. In America some cutting down of output has been achieved, but stocks are very onerous there, and demand well below normal.

The disturbed state of affairs in India has, of course, considerably upset the demand for galvanised goods, and other markets, too, which have in the past proved a lucrative opening for galvanised products have been seriously affected by the world slump in trade. The output of brass, both in America and in Europe, has also declined very materially, and this, of course, has had its direct bearing upon the fortunes of spelter. Fortunately, there are indications, though only slight, that an improvement is taking place which it is hoped will impart a little more interest into the spelter market. Quite apart from this, however, it can be said with certainty that at the present level production of spelter does not pay, and for that reason, above any, all-round improvement in the world's business affairs would be reflected in the price of zinc. Much is, of course, produced as a by-product, but, nevertheless, it seems pretty certain that purchases made on the present basis cannot lead the buyer very far astray.

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Trade Talk.

Extensions to the Acton Precious Metals Refinery of the Mond Nickel Company, Limited, were formally opened recently.

The Carnforth Hematite Iron Company (1915), Limited, is being wound up voluntarily. Mr. Harold Hockley, 5, London Wall Buildings, London, E.C., is the liquidator.

The contract for the refrigerating plant for the new Cunarder building at Clydebank has been placed by Messrs. John Brown & Company, Limited, with Messrs. J. & E. Hall, Limited, of Dartford.

The Zinc Corporation, Limited, announces that its mine at Broken Hill, N.S.W., as from May 4, will reduce its output. Until further notice, the mine will work three weeks out of every four.

The staff and workmen of Babcock & Wilcox, Limited, Lincoln, contributed the sum of £162 18s. 6d. to the Lincoln Hospital Saturday Fund during 1930.

Messrs. Henry Berry & Company, Limited, Croydon Works, Leeds, have recently executed a contract for 90 moulding machines for a well-known firm of Midland ironfounders.

The British Mannesmann Tube Company, Limited, whose works at Swansea are idle because it is impossible, they state, to continue on an economic basis, have sent a letter to every one of the 1,200 men involved. The letter states that, in view of many representations made to them, and having regard to the company's own desire to re-establish itself both for its own sake and the sake of its workpeople, they would be prepared to consider favourably a reopening of the works on a restricted basis if a sufficient number of men will intimate that they are prepared to accept the company's terms as already posted at the works. Workmen who are prepared to accept the company's terms and conditions are invited to notify the works manager.

The first annual statement of the Dominion Steel & Coal Corporation, Limited, which represents the consolidation of the British Empire Steel Corporation, the Dominion Iron & Steel Company, the Halifax Shipyards, the Cumberland Railway & Coal Company, and others, shows—according to a message from Montreal—a net profit, after all fixed charges have been provided for, of $858,000. This does not include the results of the operations of the Dominion Coal Company and the Nova Scotia Steel & Coal Company, which the new company controls through stock holdings. The net profit represents $1.2 on the Class B shares of the Corporation, which shares were issued on the formation of the Corporation as consideration for the assets and undertakings of the companies entering the amalgamation.

The scheme for the fusion of the Sheffield and North Lincolnshire interests of Messrs. John Brown & Company, Limited, and Messrs. Thos. Firth & Sons, Limited, has now been concluded. The secretary of Messrs. Thos. Firth & Sons, in a circular, states that for many years very close relations have existed between the two companies. These relations had already enabled considerable co-operation in certain works services, and the pursuance of this policy, which has become of increasing importance under the prevailing conditions of trade, has led to the joining up of the steel interests of the two companies, carried out by the transfer to Thos. Firth & Sons of John Brown's works at Sheffield and Scunthorpe, North Lincolnshire, to be operated in conjunction with the Norfolk and Tinsley Works, Sheffield, of Thos. Firth & Sons. In connection with this arrangement, Thos. Firth & Sons has increased its share capital of £2,450,000 and changed its name to Thos. Firth & John Brown, Limited, and transferred its registered office to Atlas Works, Sheffield. John Brown & Company will continue to carry on separately, under its own name, its shipyard at Clydebank and the collieries in South Yorkshire, with registered offices at Atlas Works, Sheffield. Thos. Firth & John Brown, Limited, will consequently comprise the whole of the present undertaking of Thos. Firth & Sons, and also the Atlas and Scunthorpe works of John Brown & Company. The board consists of the following:—The Hon. Henry D. McLaren (chairman), Mr. F. C. Fairholme and Mr. A. J. Grant (joint managing directors), Lord Aberconway, Sir Charles E. Ellis, Mr. Edward Dixon, Mr. Percy W. Fawcett, Mr. E. Willoughby Firth, Mr. John C. Firth and Mr. Chas. F. Spencer.

Government contracts recently placed include the following:—Admiralty: Mild-steel angles: British (Guest Keen Baldwins) Iron & Steel Company, Limited; Consett Iron Company, Limited; Dorman, Long & Company, Limited; Frodingham Iron & Steel Company, Limited; Lanarkshire Steel Company, Limited; Park Gate Iron & Steel Company, Limited; Pease & Partners, Limited; Steel Company of Scotland, Limited. Bright steel bolts, nuts, studs, etc.: Kirby Banks Screw Company, Limited; C. Lindley & Company, Limited; E. Mercer, Limited; J. C. Prestwick, Limited; C. Richards & Sons, Limited; Steel Nut & J. Hampton, Limited. Air compressors: G. & J. Weir, Limited. Steam travelling crane: Cowans, Sheldon & Company, Limited. Annealing furnace: Incandescent Heat Company, Limited. Manganese-bronze ingots: J. Stone & Company, Limited. Steel plates: British (Guest Keen Baldwins), Iron & Steel Company, Limited; Colvilles, Limited; Dorman, Long & Company, Limited; Park Gate Iron & Steel Company, Limited; Steel Company of Scotland, Limited. Propellers: Manganese, Bronze & Brass Company, Limited. Steel rods, discs, sheets and bars: Hadfields, Limited; Rotherham Forge & Rolling Mills Company; Andrews Toledo, Limited; Swift, Levick & Sons, Limited; J. Beardshaw & Son, Limited; Scottish Iron & Steel Company, Limited. Steel-wire rope: British Ropes, Limited; Whitecross Company, Limited; Bruntons (Musselburgh), Limited. Tubes: Stewarts & Lloyds, Limited. Crown Agents for the Colonies:—Corrugated steel: Wolverhampton Corrugated Iron Company, Limited. Generating plant: British Thomson-Houston Company, Limited. Locomotive tyres: S. Fox & Company, Limited. Pipes: Stanton Ironworks Company, Limited; Staveley Coal & Iron Company, Limited. Rails and fishplates: Barrow Hematite Steel Company, Limited; United Steel Companies, Limited. Steel plates: P. & W. MacLellan, Limited. Tyres: English Steel Corporation, Limited. Wire: T. Bolton & Sons, Limited; Whitecross Company, Limited, Warrington.

Company Meeting.

Hadfields, Limited.—The annual meeting of Messrs. Hadfields, Limited, was held in Sheffield. Sir Robert A. Hadfield, Bt. (the chairman), who presided, said that the world-wide depression in trade rapidly intensified during the year under review, and their company, in common with others, had suffered severely from shortage of work and increasingly severe competition in prices. They had to bear an additional handicap through the action of the present Government in their drastic and exceedingly heavy curtailment of naval requirements last year. No doubt the presence of the Naval Conference in London demanded something in the way of a gesture, and in normal times it might not have mattered very much. Coming, however, as this had done, on the top of the worst trade depression they had ever known, it had added to their burdens in a most unexpected way which it was quite impossible to foresee. The Government had highly commended them with regard to the various important improvements they had been able to effect in the efficiency of their projectiles, chiefly for the Navy, also the Army, and for coast defence, and armour-piercing projectiles for aerial attack. Hadfields stood a long way ahead in these developments as compared with the products of any other country. Owing to the great change in naval policy, the orders nowadays were very small, but work of special nature which was going was coming their way, which was some satisfaction in these times. There had been many new and important applications of one of their specialities, namely, heat-resisting steels. These were giving great satisfaction for an innumerable number of purposes. The Hadfield crushing plant employed in the construction of the Cauvery Metur Dam in the Madras Presidency, stated to be the largest in the world, had now been put into operation, and had in fact been at work for some time. It was proving in every way efficient.

Personal.

Sir Holberry Mensforth, chairman of the English Electric Company, Limited, sailed for New York last Friday on a business visit.

Mr. T. Mensforth has been appointed chief engineer of Messrs. Dorman, Long & Company, Limited, and will be in charge of the company's central engineering department. Mr. Mensforth was trained with the Metropolitan-Vickers Electrical Company, Limited, and was formerly works manager of the Darlington Rolling Mills Company, Limited.

Obituary.

Mr Christopher Darby, of Corngreaves Road, Cradley Heath, a well-known figure in the Black Country iron trade, with which he had been actively connected for many years, died on Friday, April 17. Mr. Darby, who was 83 years of age, held a position with the New British Iron Company at Cradley Heath for 35 years, and when the Corngreaves Works closed down, he started business on his own account.

Mr. William Carlow Gray died at Birmingham on April 14, in his 41st year. Before the war Mr. Gray was a lecturer on metallurgy at the Glasgow Technical School. Later he became associated with Messrs. Henry Wiggin & Company, Limited, being appointed works manager at their Newtown Row works, and later at Wiggin Street. For some years he had taken an active part in the work of the Birmingham Metallurgical Society, and it was only in December that he retired from the presidency.

Contracts Open.

Bombay, May 6.—Carriage and wagon and locomotive engine parts and fittings, for the Great Indian Peninsula Railway. The Department of Overseas Trade. (Reference G.X. 10,299.)

Chapel-en-le-Frith, May 9.—2,486 yds. of 4-, 6- and 8-in. cast-iron mains, etc., for the Rural District Council. Messrs. Brady & Partington, engineers, Chapel-en-le-Frith. (Fee £5, returnable.)

Cork, May 12.—Pumping plant. The City Engineer, Cork.

Fakous, Egypt, May 16.—765 metres of cast-iron or steel socket pipes, for the Egyptian Ministry of the Interior. The Department of Overseas Trade. (Reference G.X. 10,309.)

Rhyl, May 30.—Pumping machinery, for the Urban District Council. Mr. R. Green, consulting engineer, 37, Bennett's Hill, Birmingham. (Fee £3 3s., returnable.)

Reports and Dividends.

Howard & Bullough, Limited.—Loss of £41,176 for the year ended March 31. No ordinary dividend is recommended.

Weardale Lead Company, Limited.—The directors announce that the operations of the company do not warrant the declaration of an interim dividend.

Monk Bridge Iron & Steel Company, Limited.—Profit for 1930, after providing for bank interest, but without making any allowance for depreciation, £1,528, reducing the debit balance to £139,431.

Hopkinsons, Limited.—Profit, £41,512; brought in, £19,310; preference dividend and interim dividend of 2½ per cent. on the ordinary shares, £25,769; income tax, £10,000; final ordinary dividend of 2½ per cent., making 5 per cent., £6,781; carried forward, £18,738.

Allen-Liversidge, Limited.—Net profit for the eight months to December 31, £34,067; brought in, £14,114; final dividend on the ordinary shares of 2½ per cent., making for the eight months 5⅓ per cent., or at the rate of 8 per cent. per annum; carried forward, £16,438.

Babcock & Wilcox, Limited.—Net profit, £609,302; brought in, £75,992; to staff pension fund, £18,596; carried forward, after provision for preference dividends and two dividends of 7 per cent. each, free of tax, on the ordinary shares, making 14 per cent. for the year, £47,792.

British Oxygen Company, Limited.—Profit for the nine months to December 31, £61,899; brought in, £144,843; final dividend on the ordinary shares of 3 per cent., or 7.2d. per share, making a total for the nine months of 6 per cent.; general reserve, £83,569; carried forward, £76,861.

Associated Electrical Industries, Limited.—Profit, £372,997; brought in, £109,241; interest on debenture stock, £41,454; depreciation, £66,226; net profit, £265,317; to general reserve, £25,000; preference dividend, £76,449; dividend on the ordinary shares of 6 per cent. less tax, absorbing £162,699; carried forward, 110,411.

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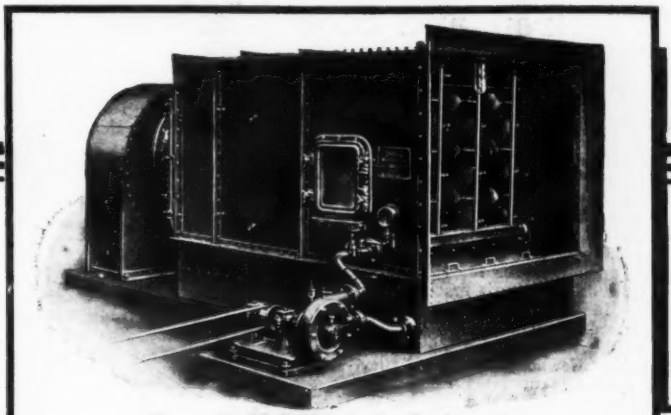

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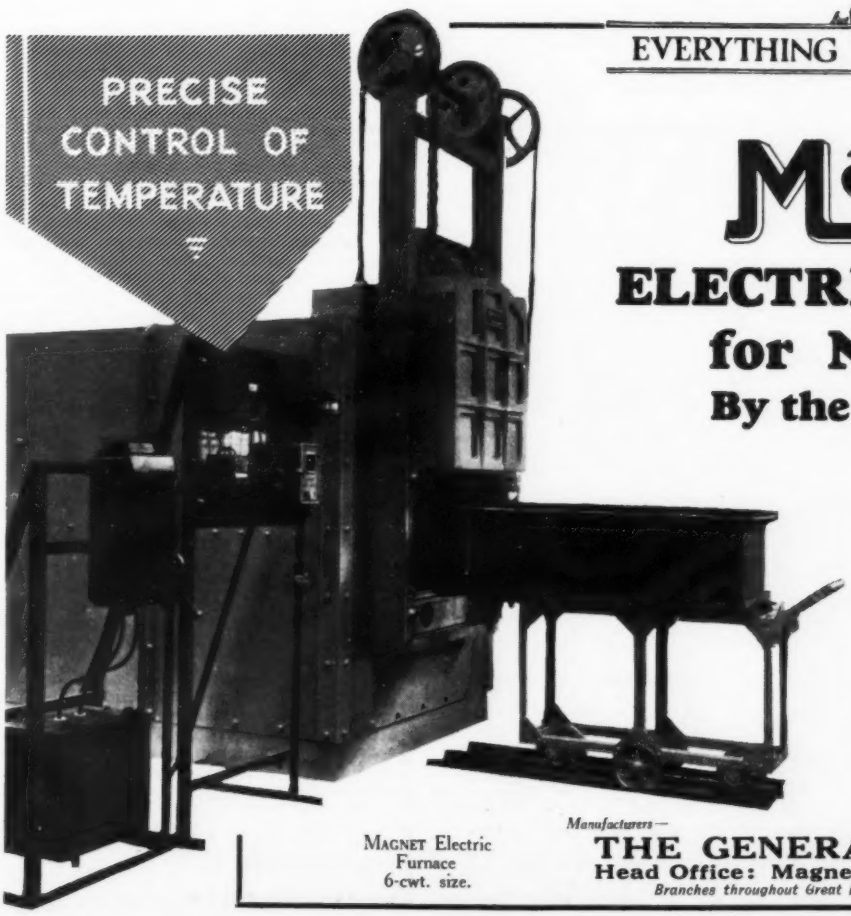

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Iron and Steel Markets.

Pig-Iron.

MIDDLESBROUGH.—The imminence of the Budget speech had a certain effect upon trade in the earlier part of last week. The many apprehensions which were entertained made purchasers cautious. The details of the Budget are now known, but the market remains depressed. The fact is that the depression of the Cleveland iron trade is deeply rooted. Local iron prices are not at a competitive level. They probably barely cover the cost of production, but iron from other areas is much cheaper, and consumers buy in the cheapest market. In their own immediate area the Cleveland ironmasters are able to meet external competition successfully, but little iron is going elsewhere. Although Cleveland makers offer specially cut rates in Scotland, they are unable to attract much business, as imported iron is offered at still lower prices. This differentiation of price in favour of the Scottish consumer seems to be a source of some resentment in the North of England. Consumers here claim, but are unable to obtain, equality of treatment, and dissatisfaction is expressed. Merchants, too, have their grievances, since they are not allowed to sell Cleveland iron in Scotland, and are also barred from supplying it to the principal local consumers. Whether this policy is profitable is a debatable point, and it is certain that, from a variety of causes, business has fallen to a very low ebb. There is no present indication of any improvement, while prices remain fixed at the following levels :—No. 1 Cleveland foundry iron, 61s.; No. 3 Cleveland G.M.B., 58s. 6d.; No. 4 foundry, 57s. 6d.; No. 4 forge, 57s. per ton.

The hematite market is rather quiet at the moment. Values have a downward tendency, which can only be arrested by an expansion in demand. The outlook of the market remains uncertain. The market price of East Coast hematite mixed numbers is now nominally 66s. per ton, although, in point of fact, realised prices of hematite show a wide variation according to the size of the order and the date of delivery. Forward prices are rather firmer than prompt, and one firm is credited with a stock of something like 40,000 tons of hematite which it refuses to sell at current rates. Nevertheless, most makers are missing no opportunity to liquidate their stocks, and very low prices have been accepted for export orders. Bessemer mixed numbers in the North-West of England are unaltered at 68s.

LANCASHIRE.—Business at the moment is unsatisfactory, and it is hoped that there will be another revival of interest in the beginning of May. Since Easter, business has been at a low ebb, and deliveries into consumption locally have, in the aggregate, been only moderate. For delivery to consumers in the Manchester price zone, Derbyshire and Staffordshire descriptions continue to be quoted at 69s. 6d. per ton, with North-East Coast iron at 69s. 6d., Northamptonshire foundry at 68s., Derbyshire forge at 64s. 6d., Scottish foundry brands at from 88s. 6d., and West Coast hematite iron at around 82s. 6d.

MIDLANDS.—Ironfounders in this area are not well placed for work, and at current levels do not feel disposed to enter into commitments apart from small quantities to cover their immediate needs. Prices are unchanged. The figures quoted by the furnaces for delivery to Birmingham and Black Country stations are 67s. 6d. for Northants No. 3 and 71s. for Derbyshire, North Staffordshire and Lincolnshire No. 3.

SCOTLAND.—Trade in Scotland is very poor. At the moment some blast furnaces are holding no orders to execute during a period of 24 hours. It seems as if the position of this market is even worse than before. The price of Scottish foundry iron is 73s. 6d. per ton, f.o.t. furnaces, with a minimum of 2s. 6d. per ton extra for No. 1. Continental No. 3 is at 52s. 6d. f.o.t. Grangemouth, with Middlesbrough No. 3 at 60s.

Finished Iron.

A poor demand is being experienced from both consumers and stock merchants. The market is still in a very disturbed state, and there is no indication of an improvement in the near future. Even the makers of marked bars, who have been fairly well occupied, are complaining of the lack of new business. Their price is reduced to £12 at works. Current quotations for crown bars in South Staffordshire vary, according to specification, from £9 5s. up to £10, while nut and bolt iron is at about £8 12s. 6d. to £8 15s. Only odd lots are being purchased by the bolt and nut makers, the bulk of the business for this grade of iron still going to Continental works. In spite of strikes at the ironworks in Belgium, supplies are still available from one source or another at rates between £4 15s. and £4 17s. 6d., delivered works.

Steel.

No improvement can be discerned in the position of the finished-steel trade. The steel manufacturers have reaffirmed the prices of sections, joists and plates. Orders are still small, and specifications involve constant changing of the rolls and consequently higher production costs. There is no increase in the number of forward contracts. The demand for small steel bars is poor, and prices are weak. The sheet trade is quiet, and there are no indications of improvement from any quarter. The situation of semi-products is also disappointing. The movement towards higher prices for Continental semis has suffered a setback, quotations being about 1s. lower on the week. A weaker tendency is now in evidence, in spite of the endeavours of the makers to keep up their quotations and in face of the fact that several mills are still out of the market. British prices are upheld, but the volume of business received by the home works is small.

Scrap.

There is little demand for iron and steel scrap in the Cleveland area. Quotations are nominal, and the market unaltered. Ordinary-quality cast-iron scrap is at 47s. 6d., with good machinery quality at 49s. New business is difficult to obtain in the Midlands, and deliveries are restricted. Good heavy machinery cast-iron scrap in cupola sizes is offered at 52s. 6d., and light cast iron is at 37s. 6d. In Scotland, little or no business is being done. There is no demand, and prices of all classes of scrap are tending to fall. Most of the consumers have entirely suspended deliveries, and it is likely to be some time before the position will improve. First-class machinery metal, in pieces not exceeding 1 cwt., is quoted at 50s., while ordinary cast-iron scrap to the same specification is at 47s. 6d. The above prices are all delivered consumers' works.

Metals.

Copper.—The question of further curtailment of output is now being discussed. Serious attention has been given to the matter, as, although American stocks of refined copper have been reduced by some 15,600 tons since the peak figure was reached at the end of last November, the rate of progress is not sufficient to rectify the statistical position within a reasonable time. Meanwhile, consumers are poorly supplied, and it is evident that cuts in price do not attract buyers, who merely look forward to the next reduction.

Closing quotations :—

Cash.—Thursday, £42 7s. 6d. to £42 8s. 9d.; Friday, £42 12s. 6d. to £42 13s. 9d.; Monday, £41 12s. 6d. to £41 13s. 9d.; Tuesday, £41 16s. 3d. to £41 17s. 6d.; Wednesday, £41 13s. 9d. to £41 15s.

Three Months.—Thursday, £43 1s. 3d. to £43 2s. 6d.; Friday, £43 5s. to £43 6s. 3d.; Monday, £42 6s. 3d. to £42 7s. 6d.; Tuesday, £42 8s. 9d. to £42 10s.; Wednesday, £42 7s. 6d. to £42 8s. 9d.

Tin.—It cannot be said that the atmosphere of this market is unduly cheerful. The market is weak, and, despite the fact that the quota scheme has been established, little improvement can reasonably be expected while consumption remains on its present reduced scale. There has been a little consumptive buying on both sides of the Atlantic, but great caution is being shown in face of the further decline in values. The statistical position is far from good, and the prospect of a further increase in visible supplies at the end of this month was a further cause for depression in the past week.

Official closing prices :—

Cash.—Thursday, £111 7s. 6d. to £111 10s.; Friday, £111 to £111 2s. 6d.; Monday, £108 2s. 6d. to £108 5s.; Tuesday, £107 5s. to £107 7s. 6d.; Wednesday, £107 17s. 6d. to £108.

Three Months.—Thursday, £112 12s. 6d. to £112 15s.; Friday, £112 7s. 6d. to £112 10s.; Monday, £109 7s. 6d. to £109 10s.; Tuesday, £108 12s. 6d. to £108 15s.; Wednesday, £109 2s. 6d. to £109 5s.

Spelter.—The general situation in this market does not inspire confidence, although it seems as if quotations have reached a level from which a further serious decline can hardly be expected. Consumers are showing very little interest.

Daily fluctuations :—

Ordinary.—Thursday, £11 5s.; Friday, £11; Monday, £10 11s. 3d.; Tuesday, £10 11s. 3d.; Wednesday, £10 12s. 6d.

Lead.—The adverse statistical position in America has had a depressing influence on this market, and so far the decision to curtail production by 15 per cent. has done little to assist the market. Here again the interest shown by consumers is small.

The week's prices have been :—

Soft Foreign (Prompt).—Thursday, £12 5s.; Friday, £12 2s. 6d.; Monday, £11 17s. 6d.; Tuesday, £12 2s. 6d.; Wednesday, £11 17s. 6d.

Students' Corner.

Q.—What is understood by cleavage ?

A.—Cleavage in a casting is that locality which will divide with the least amount of resistance, *i.e.*, the weakest part or parts of a casting, due to the meeting places of crystal boundaries at corners and sharp right angles. Flanges and sharp corners, when angled or filleted, minimise the weak plane, by making the skeleton crystal boundaries more irregular and intersected, and hence comparatively strong. Even an inch cube of cast iron, if cast as a cube, will have six pyramidal planes of cleavage. When an inch-round piece one inch long is cast, there are no such planes or lines of cleavage. That is why all sharp corners in castings should be avoided, and also why round test-pieces are stronger than square test-pieces.

Q.—When a casting has cooled and remains cold, are the crystals, or is the crystal structure, at rest ?

A.—Evidence seems to indicate that this is not the case. It is known that castings have been brought direct from the foundry to the machine shop and at once planed, and that in a month's time the planed parts have not remained true; the castings have had to be returned to the planing machine and replaned. Owing to this phenomenon it is the custom of many engineering shops to rough-machine new castings, with considerable surface areas which have to be planed, and then allow the castings to rest or "weather" for some weeks before replaning. It is stated that the second planing remains accurate. The writer has known turbine cylinder castings weighing between 20 and 30 tons, the joints of which are of considerable area, to be planed in the usual way, and that when the assembled cylinder was subjected to pressure test, the joints could not be made tight until they were replaned, after which there was no trouble.

Q.—Do all metals and alloys crystallise alike ?

A.—In general this is so, as metals and alloys are products of crystallisation. The size of the grains depends largely upon the length of time taken up during solidification, the nature of the material and its purity. When an alloy freezes through a wide range of temperature, the high melting-point materials fall out of solution, and give skeleton outlines of crystal grain. This development of progressive crystallisation, with alloys is subject to defects which depend upon the range of temperature through which the alloy freezes, rate of cooling, etc. The crystal of metallurgy is quite irregular, and may be referred to as "crystal grain."

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~~Commercial Manager~~
General Manager

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Tough	42	10	0
Best selected	43	0	0
Sheets	75	0	0
India	55	0	0
Wire bars	46	8	9
Do., May	46	8	9
Do., June	46	8	9
Ingot bars	46	8	9
H.C. wire rods	47	10	0
Off. av. cash, March	44	17	2¼
Do., 3 mths., March	45	7	6 15/32
Do., Sttlmnt., March	44	17	4 7/16
Do., Electro, March	48	3	4 1/16
Do., B.S., March	46	9	8 3/32
Do., wire bars, March	48	12	10 1/16
Solid drawn tubes			10¾d.
Brazed tubes			10¾d.
Wire			6¾d.

BRASS.

Solid drawn tubes	9½d.
Brazed tubes	11½d.
Rods, drawn	9½d.
Rods, extd. or rlld.	5½d.
Sheets to 10 w.g.	8½d.
Wire	8½d.
Rolled metal	7½d.
Yellow metal rods	5½d.
Do. 4 × 4 Squares	6d.
Do. 4 × 3 Sheets	6½d.

TIN.

	£	s.	d.
Standard cash	107	17	6
Three months	109	2	6
English	109	0	0
Bars	110	5	0
Straits	109	7	6
Australian	108	10	0
Eastern	110	12	6
Banca	110	5	0
Off. av. cash, March	121	18	4 1/16
Do., 3 mths., March	123	8	4 5/32
Do., Sttlmt., March	121	18	2 1/16

SPELTER.

	£	s.	d.
Ordinary	10	12	6
Remelted	9	15	0
Hard	8	10	0
Electro 99.9	12	15	0
English	11	0	0
India	9	15	0
Zinc dust	19	0	0
Zinc ashes	2	15	0
Off. aver., March	12	8	7 13/32
Aver. spot, March	12	3	9 9/32

LEAD.

	£	s.	d.
Soft foreign ppt.	11	17	6
English	13	5	0
Off. average, March	13	4	9 11/32
Average spot, March	13	2	6 1/32

ZINC SHEETS, &c.

	£	s.	d.
Zinc sheets, English	20	0	0
Do., V.M. ex-whf.	19	0	0
Rods	22	12	6
Boiler plates	13	10	0
Battery plates	15	0	0

ANTIMONY.

	£	s.	d.
Special brand, Eng.	36	0	0
Chinese	24	0	0
Crude	22	0	0

QUICKSILVER.

	£	s.	d.
Quicksilver	21	8	6

FERRO-ALLOYS AND STEEL-MAKING METALS.

Ferro-silicon—	
25%	£7 0 0
45/50%	£10 0 0
75%	£15 15 0
Ferro-vanadium—	
35/50%	12/8 lb. Va.
Ferro-molybdenum—	
70/75% c. free	4/2 lb. Mo.
Ferro-titanium—	
23/25% carbon-free	10d. lb.
Ferro-phosphorus, 20/25%	£15 15 0
Ferro-tungsten—	
80/85%	1/8½ lb.
Tungsten metal powder—	
98/99%	1/11½ lb.
Ferro-chrome—	
2/4% car.	£29 0 0
4/6% car.	£21 0 0
6/8% car.	£19 15 0
8/10% car.	£19 0 0
Ferro-chrome—	
Max. 2% car.	£30 0 0
Max. 1% car.	£33 5 0
Max. 0.70% car.	£36 0 0
70%, carbon-free	10d. lb.
Nickel—99% £170 0 0 to £175 0 0	
Ferro-cobalt	9/– lb.
Aluminium 98/99%	£85 0 0
Metallic chromium—	
96/98%	2/7 lb.
Ferro-manganese (net)—	
76/80% loose	£11 0 0
76/80% packed	£12 0 0
76/80% export	£ 9 0 0
Metallic manganese—	
94/96% carbonless	1/3 lb.

Per ton unless otherwise stated.

HIGH-SPEED TOOL STEEL.

Finished bars, 14% tungsten	£0 2 0
Finished bars, 18% tungsten	£0 2 9

Per lb. net, d/d buyers' works.

Extras—

Rounds and squares, 3 in. and over	4d. lb.
Rounds and squares, under ½ in. to ¼ in.	3d. lb.
Do., under ¼ in. to 7/32 in.	1/– lb.
Flats, ½ in. × ¼ in. to under 1 in. × ⅜ in.	3d. lb.
Do., under ½ in. × ¼ in.	1/– lb.
Bevels of approved sizes and sections	6d. lb.

Bars cut to length, 10% extra.

SCRAP.

	£	s.	d.		£	s.	d.
South Wales							
Heavy steel	2	6	6	to	2	7	6
Bundled steel and shrngs.	1	18	6	to	2	3	0
Mixed iron and steel	1	17	6	to	2	1	0
Heavy cast iron	2	7	0	to	2	8	6
Good machinery for foundries					2	12	6
Cleveland—							
Heavy steel					2	2	6
Steel turnings					1	7	6
Cast-iron borings					1	3	6
Heavy forge					2	15	0
W.I. piling scrap					2	11	6
Cast-iron scrap	2	7	6	to	2	9	0
Midlands—							
Light cast-iron scrap					1	17	6
Heavy wrought						—	
Steel turnings						—	
Scotland—							
Heavy steel					2	5	0
Ordinary cast iron					2	7	6
Engineers' turnings					1	12	6
Cast-iron borings					1	13	0
Wrought-iron piling					2	12	6
Heavy machinery					2	10	0

London—Merchants' buying prices delivered yard.

Copper (clean)	34 10 0
Brass	24 0 0
Lead (less usual draft)	10 0 0
Tea lead	7 0 0
Zinc	5 10 0
New aluminium cuttings	50 0 0
Braziery copper	30 10 0
Gunmetal	31 0 0
Hollow pewter	76 0 0
Shaped black pewter	56 0 0

PIG-IRON.

(f.o.t. unless otherwise stated.)

N.E. Coast—	
Foundry No. 1	61/–
Foundry No. 3	58/6
Foundry No. 4	57/6
Forge No. 4	57/–
Hematite No. 1	66/6
Hematite M/Nos.	66/–
N.W. Coast—	
Hem. M/Nos. d/d Glas.	74/–
„ d/d Birm.	86/6
Malleable iron d/d Birm.	117/6
Midlands—	
Staffs common*	—
„ No. 4 forge*	66/–
„ No. 3 fdry.*	71/–
Shrops basic	—
„ Cold blast ord.	—
„ „ roll iron	—
Northants forge*	62/6
„ fdry. No. 3*	67/6
„ fdry. No. 1*	70/6
Derbyshire forge*	66/–
„ fdry. No. 3*	71/–
„ fdry. No. 1*	74/–
„ basic*	—

*d/d Black Country dist.

Scotland—	
Foundry No. 1	76/–
„ No. 3	73/6
Hem. M/Nos. d/d	72/–
Sheffield (d/d district)—	
Derby forge	61/–
„ fdry. No. 3	66/–
Lincs forge	—
„ fdry. No. 3	66/–
E.C. hematite	81/6
W.C. hematite	84/6
Lancashire (d/d eq. Man.)—	
Derby forge	64/6
„ fdry. No. 3	69/6
Staffs fdry. No. 3	69/6
Northants fdry. No. 3	68/–
Cleveland fdry. No. 3	69/6
Dalzell, No. 3 (special)	105/– to 107/6
Summerlee, No. 3	88/6
Glengarnock, No. 3	—
Eglinton, No. 3	88/6
Gartsherrie, No. 3	88/6
Monkland, No. 3	88/6
Shotts, No. 3	88/6

FINISHED IRON AND STEEL.

Usual District deliveries for iron; delivered consumers' station for steel.

	£	s.	d.		£	s.	d.
Iron—							
Bars (cr.)	10	0	0	to	10	10	0
Nut and bolt iron	8	12	6	to	8	15	0
Hoops	10	10	0	to	12	0	0
Marked bars (Staffs) f.o.t.					12	0	0
Gas strip	10	10	0	to	12	0	0
Bolts and nuts, ¾ in. × 4 in.					14	5	0
Steel—							
Plates, ship, etc.	8	15	0	to	8	17	6
Boiler plts.	9	0	0	to	9	15	0
Chequer plts.					10	7	6
Angles					8	7	6
Tees					9	7	6
Joists					8	15	0
Rounds and squares, 3 in. to 5½ in.					9	7	6
Rounds under 3 in. to ⅜ in. (Untested)	7	2	6	to	7	15	0
Flats—8 in. wide and over					8	12	6
„ under 8 in. and over 5 in.					8	17	6
Rails, heavy	8	5	0	to	8	10	0
Fishplates					12	0	0
Hoops (Staffs)	9	5	0	to	9	10	0
Black sheets, 24g.	8	10	0	to	9	10	0
Galv. cor. shts. 24g.					11	0	0
Galv. flat sheets					11	10	0
Galv. fencing wire, 8g. plain					12	0	0
Billets, soft	5	2	6	to	5	12	6
Billets, hard	7	2	6	&	up.		
Sheet bars	5	0	0	to	5	7	6
Tin bars	5	0	0	to	5	7	6

PHOSPHOR BRONZE.

	Per lb. basis.
Strip	11½d.
Sheet to 10 w.g.	11¾d.
Wire	1/0¾
Rods	11¾d.
Tubes	1/6¾
Castings	11¾d.

Delivery 3 cwt. free.
10% phos. cop. £30 above B.S.
15% phos. cop. £35 above B.S.
Phosphor tin (5%) £30 above price of English ingots.
C. Clifford & Son, Limited.

NICKEL SILVER, &c.

	Per lb.
Ingots for raising	7d. to 1/1
Rolled—	
To 9 in. wide	1/1 to 1/7
To 12 in. wide	1/1½ to 1/7½
To 15 in. wide	1/1½ to 1/7½
To 18 in. wide	1/2 to 1/8
To 21 in. wide	1/2½ to 1/8½
To 25 in. wide	1/3 to 1/9
Ingots for spoons and forks	7d. to 1/3½
Ingots rolled to spoon size	10d. to 1/6½
Wire round—	
3/– to 10 g.	1/4½ to 1/11½

with extras according to gauge.
Special 5ths quality turning rods in straight lengths, 1/3½ upwards.

AMERICAN IRON AND STEEL.

At Pittsburgh unless otherwise stated.

	Dols.
No. 2 foundry, Phila.	17.76
No. 2 foundry, Valley	17.00
No. 2 foundry, Birm.	12.00
Basic	18.26
Bessemer	18.76
Malleable	18.76
Grey forge	17.26
Ferro-mang. 80%	80.00
O.-h. rails, h'y, at mill	43.00
Billets	30.00
Sheet bars	30.00
Wire rods	35.00
	Cents.
Iron bars, Phila.	2.09
Steel bars	1.65
Tank plates	1.65
Beams, etc.	1.65
Skelp, grooved steel	1.65
Skelp, sheared steel	1.65
Steel hoops	1.85
Sheets, black, No. 24	2.35
Sheets, galv., No. 24	2.85
Sheets, blue an'l'd, No. 13	2.05
Wire nails	1.90
Plain wire	2.20
Barbed wire, galv.	2.55
Tinplates, 100-lb. box	$5.00

COKE (at ovens).

Welsh foundry	22/6 to 25/–
„ furnace	15/– to 16/–
Durham and Northumberland—	
„ foundry	13/6 to 14/–
„ furnace	13/6
Midlands, foundry	—
„ furnace	—

TINPLATES.

f.o.b. Bristol Channel ports.

I.C. cokes	20×14 box	15/- to 15/3
„	28×20 „	30/– to 30/6
„	20×10 „	21/10½
„	18¾×14 „	15/10½
C.W.	20×14 „	14/3
„	28×20 „	28/3 to 28/6
„	20×10 „	21/–
„	18¾×14 „	14/9 to 15/–
Terneplates	28×20	31/– per box basis f.o.b.

SWEDISH CHARCOAL IRON & STEEL.

Pig-iron	£6	0	0	to	£7	10	0
Bars, hammered, basis	£17	10	0	to	£18	10	0
Bars and nail-rods, rolled, basis	£15	17	6	to	£16	15	0
Blooms	£10	0	0	to	£12	0	0
Keg steel	£32	0	0	to	£33	0	0
Faggot steel	£20	0	0	to	£24	0	0
Bars and rods dead soft, st'l	£11	0	0	to	£14	0	0

All per English ton, f.o.b. Gothenburg.

XUM

TUBES AND FITTINGS.
Over ¼ in. up to 6 in.

	Tubes.	*Fittings.*
Gas	62½%	47½%
Water	58½%	42½%
Steam	55%	37½%

W.I. 12½% extra.

DAILY FLUCTUATIONS.

Standard Copper (cash).

		£	s.	d.	
Apr. 23		42	7	6	dec. 3/9
,, 24		42	12	6	inc. 5/-
,, 27		41	12	6	dec. 20/-
,, 28		41	16	3	inc. 3/9
,, 29		41	13	9	dec. 2/6

Electrolytic Copper.

		£	s.	d.	
Apr. 23		45	10	0	dec. 10/-
,, 24		45	10	0	No change
,, 27		44	10	0	dec. 20/-
,, 28		44	10	0	No change
,, 29		44	5	0	dec. 5/-

Standard Tin (cash).

		£	s.	d.	
Apr. 23		111	7	6	inc. 7/6
,, 24		111	0	0	dec. 7/6
,, 27		108	2	6	,, 57/6
,, 28		107	5	0	,, 17/6
,, 29		107	17	6	inc. 12/6

Tin (English ingots).

		£	s.	d.	
Apr. 23		112	10	0	inc. 10/-
,, 24		112	0	0	dec. 10/-
,, 27		109	5	0	,, 55/-
,, 28		108	5	0	,, 20/-
,, 29		109	0	0	inc. 15/-

Zinc Sheets (English).

		£	s.	d.	
Apr. 23		20	0	0	No change
,, 24		20	0	0	,, ,,
,, 27		20	0	0	,, ,,
,, 28		20	0	0	,, ,,
,, 29		20	0	0	,, ,,

Spelter (ordinary).

		£	s.	d.	
Apr. 23		11	5	0	No change
,, 24		11	0	0	dec. 5/-
,, 27		10	11	3	,, 8/9
,, 28		10	11	3	No change
,, 29		10	12	6	inc. 1/3

Lead (English).

		£	s.	d.	
Apr. 23		13	15	0	No change
,, 24		13	10	0	dec. 5/-
,, 27		13	5	0	,, 5/-
,, 28		13	10	0	inc. 5/-
,, 29		13	5	0	dec. 15/-

Imports and Exports of Iron Castings in March and the three months 1931, compared with March and the three months 1930.

	March, 1930.	March, 1931.	Three months, 1930.	Three months, 1931.	March, 1930.	March, 1931.	Three months, 1930.	Three months, 1931.
Imports.	Tons.	Tons.	Tons.	Tons.	£	£	£	£
Pipes and Fittings, Cast	2,867	1,059	8,011	3,132	34,434	13,672	95,571	39,419
Castings, in the Rough, Iron	163	156	717	538	3,686	3,045	15,535	10,560
,, ,, ,, Steel	1,606	515	4,585	1,746	36,651	11,177	107,244	38,928
Hollow-ware, Cast, not Enamelled	1	1	7	16	137	116	862	1,139
,, ,, Enamelled	1	6	5	33	68	346	329	1,398
Exports.								
BUILDERS' CASTINGS—								
To Argentine Republic	263	99	658	289	12,286	4,213	26,083	12,909
,, British South Africa	145	142	646	405	6,357	5,776	25,617	16,704
,, ,, India	136	163	478	392	4,920	5,309	16,979	13,177
,, Australia	41	8	158	39	2,528	323	9,822	1,618
,, New Zealand	87	56	316	144	5,132	4,306	18,707	9,318
Total (including other countries)	1,420	1,186	4,850	3,337	68,109	53,255	214,429	153,574
PIPES AND FITTINGS—CAST—								
To Argentine Republic	1,429	802	3,672	2,069	13,855	7,794	35,719	19,838
,, British South Africa	594	751	3,116	2,862	7,315	8,228	32,778	33,797
,, ,, India	177	143	1,167	422	3,189	2,801	17,914	8,588
,, Straits Settlements and Malay States	191	199	1,693	551	2,575	2,484	16,599	6,819
,, Ceylon	25	7	235	46	456	134	2,904	635
,, Australia	113	5	372	82	2,027	200	6,361	1,567
Total (including other countries)	9,919	5,275	32,611	18,457	113,361	63,669	357,424	213,422
HOLLOW-WARE—								
Cast, not Enamelled, and Cast, Tinned	376	204	1,227	658	11,581	7,216	38,612	21,791
,, Enamelled	52	33	194	151	5,146	3,903	16,822	15,133
CASTINGS, in the rough—								
Iron	355	80	946	407	6,207	2,617	23,414	15,182
Steel	197	256	704	487	8,083	6,753	25,220	16,529

WILLIAM JACKS & COMPANY,
WINCHESTER HOUSE, OLD BROAD ST., LONDON, E.C.2.

18, BENNETTS HILL, BIRMINGHAM.
13, RUMFORD STREET, LIVERPOOL.

PIG

IRON

All grades FOUNDRY, HEMATITE, BASIC, SPECIALS, &c.

NON-FERROUS METALS

COPPER, TIN, LEAD, SPELTER, ANTIMONY, CHROME ORE.

WILLIAM JACKS & COMPANY,
19, ST. VINCENT PLACE, GLASGOW.
ZETLAND ROAD, MIDDLESBROUGH.

SITUATIONS VACANT AND WANTED.

QUALCAST, LIMITED, require energetic Foundry Representatives, preferably resident London and Birmingham. Those with connections among users of Repetition Grey-iron Castings preferred.—Reply by letter only, giving age, salary, previous experience, to Sales Manager, Qualcast, Limited, Derby.

MOULDING Shop Head wanted for large foundry manufacturing highly-ornamental heavy and light castings. Must have thorough knowledge of all foundry practices. State age, qualifications, and salary. Highest references required.—Address, "Castings," Wm. Forteous & Company, Advertising Agents, Glasgow.

EMPLOYMENT REGISTER.

Conducted by the Institute of British Foundrymen by courtesy of the proprietors of The Foundry Trade Journal.

Any Member, Associate Member or Associate of the Institute of British Foundrymen who desires his qualifications to be inserted in the column must forward to the General Secretary of the Institute the following information:—(a) Name and address; (b) name of present employer (or last employer if unemployed); (c) brief particulars of qualifications, experience, and type of position required. The name will not be disclosed until the candidate is in communication with a prospective employer. Announcements will be inserted in two successive issues, unless announcers' requirements have been met with in the meantime.

Any employer wishing to communicate with a candidate should write to the General Secretary, quoting identification number.

The Institute of British Foundrymen and the Proprietors of The Foundry Trade Journal wish it to be clearly understood that they accept no legal responsibility in connection with this service, for which no charge is made to members of the I.B.F.

Correspondence should be addressed to the General Secretary, Institute of British Foundrymen, St. John Street Chambers, Deansgate, Manchester.

FOUNDRY Manager seeks re-engagement; 15 years' experience in responsible positions. Steam engines, pumps, mill gearing, general engineering. Used to heavy work, including loam, also machine and plate moulding. (103)

POSITION required as Foundry Foreman. Wide experience in iron and steel foundry practice, moulding machines and continuous casting, also sand and loam moulding up to 50 tons. Technically trained. (104)

POSITION required as Foreman or as Assistant Manager of large foundry. Eleven years' experience as foundry foreman in iron, steel and non-ferrous castings, including aluminium. Experience includes machine and loam moulding; has had fitting and machine-shop experience and can fill position as maintenance engineer. (105)

EXPERIENCED Foundryman requires supervisory position. Long experience in high-class internal-combustion engines and electrical castings; iron and non-ferrous; experienced in control of mixtures. (106)

YOUNG Moulder with sound technical training requires progressive position as Foreman or Assistant. Sound experience in marine and general engineering castings. (107)

PROCESS FOR SALE.

TO Iron Foundries.—For Sale, Process for manufacturing Stainless Iron on an economical basis suitable for making speciality castings on mass production such as road studs and guides, agricultural castings, etc.—Write for full particulars to Box 794, Offices of The Foundry Trade Journal, 49, Wellington Street, Strand, London, W.C 2.

TENDER.

METROPOLITAN WATER BOARD.

TENDERS FOR THE SUPPLY OF STORES, ETC.

THE Metropolitan Water Board invite Tenders for the supply of the undermentioned Stores and Services, etc., for periods of 6 and 12 months, commencing June 1, 1931:—

Tender No.

1.—Bricks, firebricks, cement, etc.
8.—Iron and steel.
9.—Bolts and nuts, screws, files, shovels, steam tubes, etc.
12.—Fuel oil, oils (lubricating), kerosene, motor spirit, greases, tallow, etc.
19.—Iron, brass, gunmetal and other castings.
20.—G.M. stopcocks and ferrules, outlets and caps for fire hydrants.
22.—Timber.
23.—Maintenance of weighing machines.

Tenders must be submitted on the official forms, which may be obtained from the Chief Engineer by personal application at the offices of the Board (Room 155) or upon forwarding a stamped addressed sack envelope.

Applicants should refer to the number of the Tender for which forms are required.

Tenders, enclosed in sealed envelopes, addressed to "The Clerk of the Board" and endorsed in the manner indicated in the Form of Tender, must be delivered at the offices of the Board (Room 122) not later than 11 a.m. on Monday, May 11, 1931.

The Board do not bind themselves to accept the lowest or any Tender.

G. F. STRINGER,
Clerk of the Board.

Offices of the Board,
173, Rosebery Avenue, E.C.1,
April 18, 1931.

PROPERTY.

MAGNIFICENT

11 ACRES WORKS SITE.

SHEFFIELD.

145,000 Sq. Ft. of Shops.

SIDING CONNECTIONS

with L.M. & S. and L. & N.E. Rlys.

WELL-BUILT & COMMODIOUS OFFICES

Will Sell whole or in lots to suit customers or Let on favourable terms. Unique opportunity for Manufacturers.

Apply—

THOS. W. WARD, LTD.,
ALBION WORKS, SHEFFIELD.

FOR SALE.

FOUNDRY BLACKING AND COAL-DUST MANUFACTURING WORKS,
Comprising Main Buildings, Sheds, Goods Entrance, etc. Adjoining railway siding; recently restored and in first-class condition.

Plant consists of new 60-h.p. Lancashire Dynamo Company's Electric Motor, ventilated, dust-proof type; one 30-h.p. Mavor Coulson Company's Electric Motor in excellent running order. Both these motors certified, tested and passed by National Boiler & General Insurance Company.

The Manufacturing Plant for both Foundry Blackings and Coal Dust are complete and in excellent working order. The grinding, mixing and screening machines recently thoroughly overhauled are largely automatic, very little labour being required.

The Coal-dust Plant is right up to date, and driven by the 30-h.p. Motor; consists of Christy & Norris Disintegrator, Balloon Dust Collector and Screen for grading purposes. Including Shafting and Belting, all complete.—Box 778, Offices of The Foundry Trade Journal, 49, Wellington Street, Strand, London, W.C.2.

PROPERTY—*Continued.*

BRISTOL.

TO Engineers, Founders, Manufacturers.—Fine site of nearly three acres on arterial road, with Foundry and Workshops and own Rail Sidings into the premises. Modern Offices, Warehouses and Workrooms. Central Heating.—Charles A. Tricks & Son, Auctioneers, St. Nicholas Street, Bristol.

MACHINERY.

MOULDING Machine wanted, modern and in good order; turnover table 78 x 60 in.—Write, Lumbys, Greetland, Halifax.

WANTED, Good Secondhand Hand Press Moulding Machine, suitable for Snap Flask work only, for boxes 12 in. x 12 in. x 4 in. deep.—Particulars, price, to Audley Engineering Company, Limited, Newport (Shropshire).

SAND MIXERS.—New and Secondhand. Ask us to quote.—W. Brealey & Company, Limited, Station Works, Ecclesfield, Sheffield.

FOR Sale, Denison Foundry Testing Machine for tensile and transverse tests. In perfect condition.—T. C. Howden & Company, 7, Fleet Street, Birmingham.

'Phone: 287 SLOUGH

MORGAN

TILTING FURNACES

150 lb. "S" type cokefired	£38
250 lb. "S" type cokefired	£48
450 lb. "S" type cokefired	£80
450 lb. "A" type cokefired	£80
250 lb. "SA" type oilfired	£53
450 lb. "SA" type oilfired	£85
1,000 lb. "SA" type oilfired	£110

Every furnace supplied relined and ready for use.

BUY FROM ME AND SAVE MONEY!

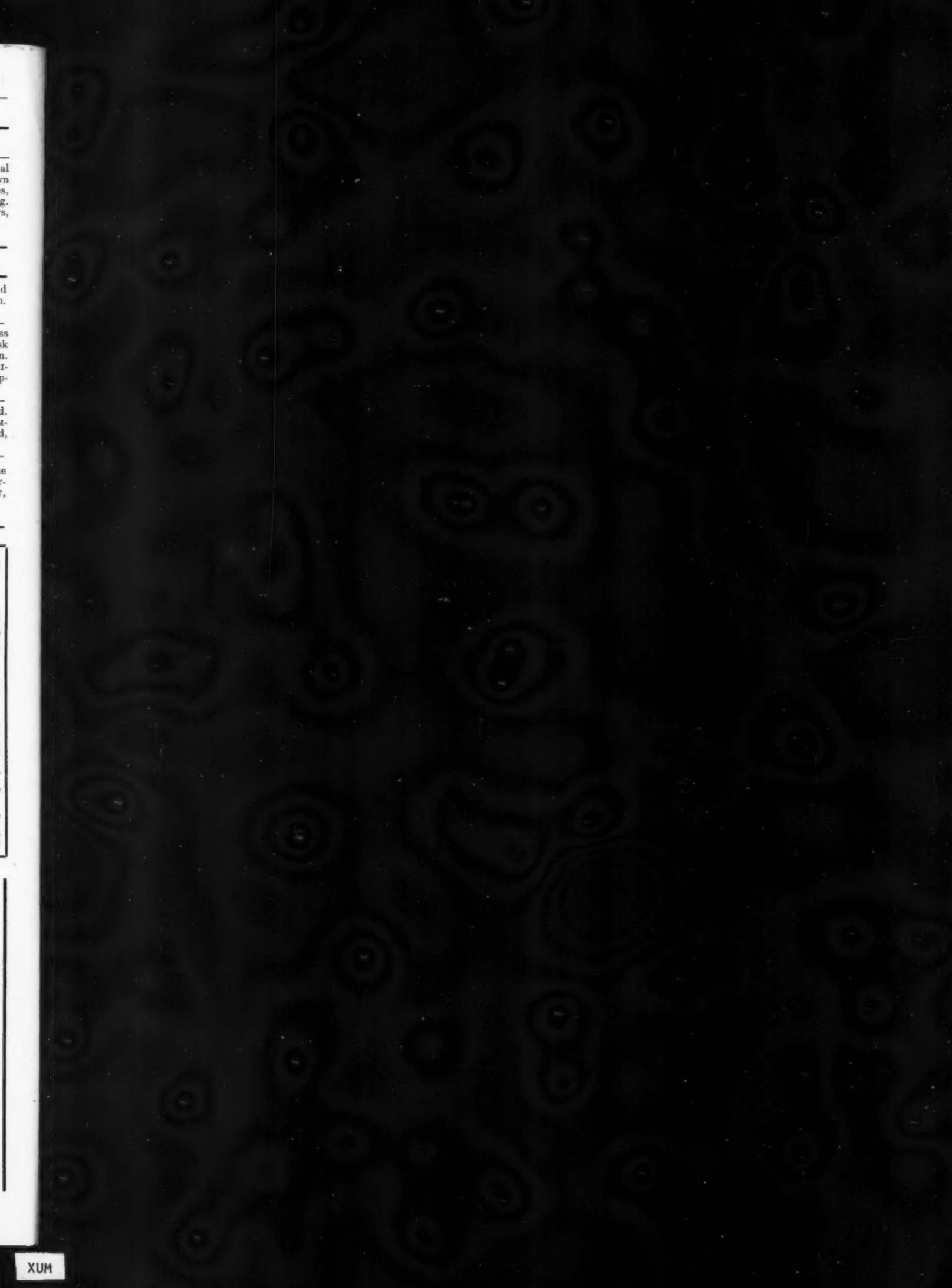
ALEX. HAMMOND, *Foundry Machinery Merchant,*
14, AUSTRALIA ROAD, SLOUGH

THE ORIGINAL MAKERS

Bradley's

DEGASIFIED
REFINED PIG IRONS

FOR
ALL CLASSES OF
HIGH DUTY
CASTINGS

BRADLEY & FOSTER LTD
DARLASTON - - STAFFS.

Phone: Darlaston 16. 'Grams: "Bradley's, Darlaston."